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News-Record

A Consolidation of Engineering News, Engineering Record
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Lighting the Mount Vernon Highway

Double row of 6,000-lumen lamps carried 20 and 17 ft. above the roadway throw light directly on roadway every 150 ft. in the 15 miles from Washington to Mount Vernon

THE MEMORIAL HIGHWAY constructed last year out of the nation's capitol to the old home of the first president at Mount Vernon, Va., is now a lighted way. On April 26 the 15-mile twin rows of lamps 300 ft. apart were lighted. This elaborate service to night traffic is a part of a fundamental design purpose of producing in this national road a complete modern highway. It was the same purpose that added landscaping, roadside outlooks and the many traffic safety and service devices of clover leaves, circles, split roadways, bus stops and terminal loops. Reactively these devices emphasized the necessity of lighting and created the main lighting problem.

The Mount Vernon Highway (*ENR*, July 23, 1931, p. 124) is a minimum 40-ft. road paved its full length, about half with a bituminous surface and half with concrete. Design distinction does not exist so much in the surfacing and alignment (although these are representative of modern practice) as in roadway planning, to serve safely the requirements of a special character of traffic. This is in large measure return traffic and, to continue railway terminology, also stopover traffic. Much of it is bus traffic to the suburbs adjacent to the route and to Alexandria and Mount Vernon and return. A part is made up of motorists out for a drive along the river, tarrying at places affording attractive river views and returning. Another, and of course a controlling part, is made up of visitors by automobile and bus to Mount Vernon; they park their cars and return later. Virtually all is fast-moving travel, with many halts and diversions of parts of the traffic stream that later join the main current.

To serve this traffic, the road provides widenings and turnouts for bus stops and to places giving views over the river, widenings and islands for turning back at convenient intervals, and a return loop and large parking space at the Mount Vernon terminal. All these places providing for changes in traffic flow required special consideration in designing the lighting, so that the traffic changes would take place

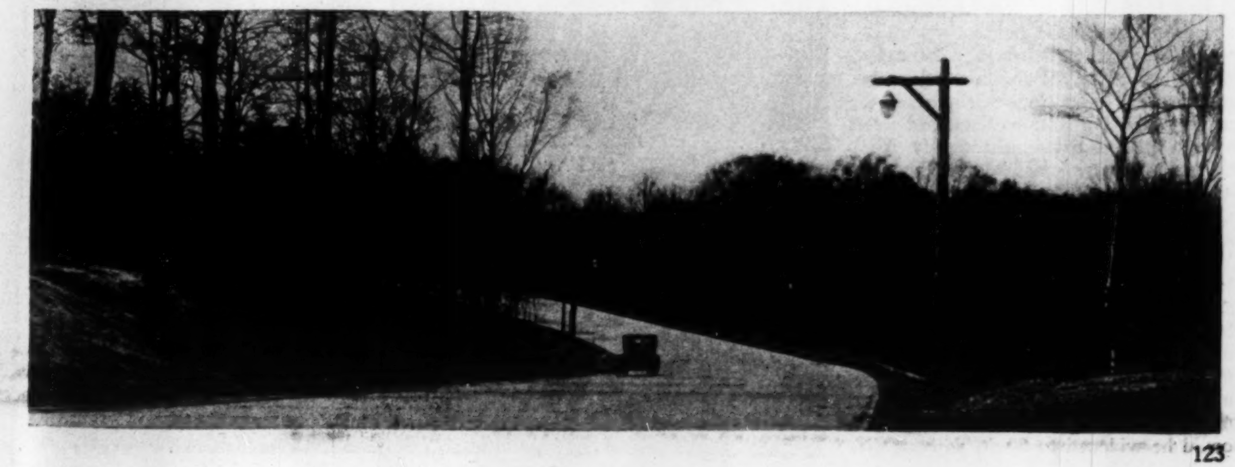


Fig. 1—Rustic cedar light standard used between Alexandria and Mount Vernon to harmonize with wooded background.

under the best possible conditions of visibility that could be created.

Theory of lighting

The lighting objective was roadway visibility. It was the purpose of the lights to make the road open and clear to vision, without need of headlight illumination to show the condition of the way; consideration of the light spacing as marking the roadway boundaries or as architectural finish—as, for example, is usual in bridge lighting—had no part in the planning. The lights were located to provide visibility of roadway and particularly clear visibility of places where traffic halted or turned or otherwise changed direction, speed or volume. The light standards and lights were made attractive as an essential part of good road design, but their purpose was to give light by which the traveler could see the road clearly. Light location was predicated on this theory.

It was found that the technique of roadway lighting was not well defined. It is generally considered good practice in lighting broad highways to mount the lamps in pendant fixtures, so that they are not farther from the center of the highway than the edge of the pavement; to secure mounting heights, preferably, of not less than 20 ft.; to establish the spacing at no more than eight or ten times the mounting height; and to increase the spacing as the mounting height is increased. In so far as possible, the plans for lighting the highway embodied all these established principles.

The decision to use rustic cedar light standards on the section from Alexandria to Mount Vernon, to harmonize with the wooded background of this section, limited the mounting height to a certain extent. A mounting height of 17 ft. was used, with the lighting fixture suspended from a cross-arm at a distance of 3 ft. from the pole. The standards were placed 4 ft. from the edge of the pavement. It is probable that a mounting height of 18 ft. could have been obtained with this type of standard without having the standard appear too massive because of the natural taper of the pole.

On the section between Washington and Alexandria metal standards were used, with a mounting height of 20 ft. and the lighting fixture suspended from a mast arm at a distance of 4 ft. from the pole. These standards were placed 4 ft. from the edge of the pavement along sections of pavement of 60-ft. single width. The entire section from Washington to Alexandria was graded to accommodate a 60-ft. pavement, although only a 40-ft. pavement was built for the greater portion of the distance. Along these sections of pavement of 40-ft. width the lighting standards were placed 14 ft. from the edge of the pavement, so that the pavement could be widened to 60 ft. without disturbing the lighting installation. With both types of standards the spacing is less than ten times the mounting height.

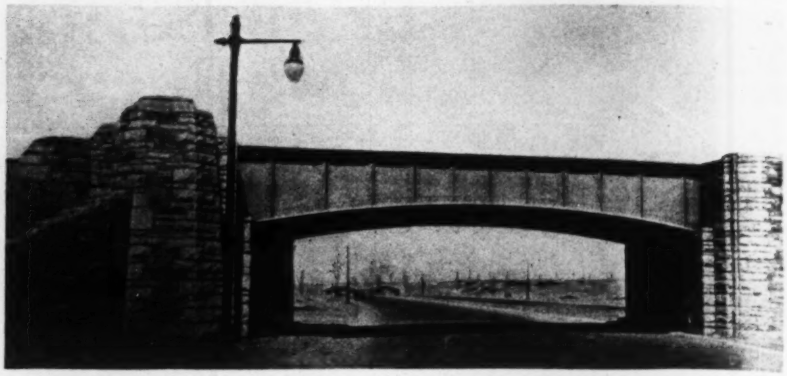


Fig. 2—Metal light standards at grade separations near Arlington end of highway.

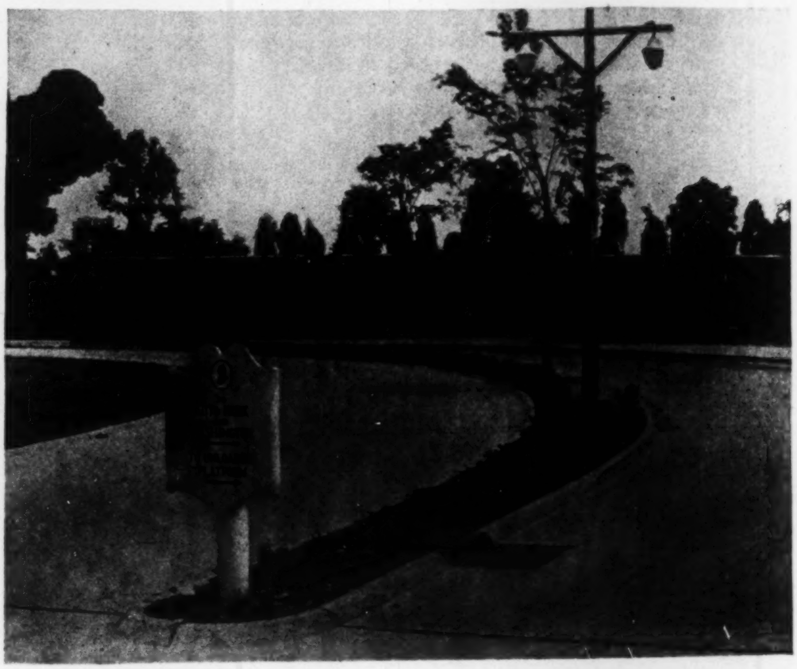
There was some question as to whether the lights should be placed all on one side of the road, or whether a staggered arrangement of lights on both sides of the road would be preferable. Decision was finally made somewhat arbitrarily on a row of single lights on each side of the road, with the lights in opposite rows staggered to bring a light at about every 150 ft. along the road. The lights were 6,000-lumen, 20-amp. lamps in suspension fixtures, with rippled glass globes and symmetric dome refractors to Alexandria, and beyond Alexandria the same lamps with an aluminum canopy and bowl refractor were used.

Regular spacing of the lights 150 ft. apart prevailed only along the standard four-lane sections of roadway. At split roadways, intersections and circles and at the Mount Vernon loop the standard spacing was varied as conditions indicated would give the best roadway visibility. Some of these special arrangements are indicated by the sketches of Fig. 4. The grouping of lights where circles and other intersections require even visibility and the placing of lights where clear visibility is necessary for the driver to pick out well ahead the points of islands, as at *A*, *B* and *C*, will be noted. In every case a degree of roadway visibility is sought that will enable the driver to discern all the evidence that daylight affords of roadway conditions that determine the safe direction of his vehicle.

Lighting details

The lighting details included the usual elements of light standards, lighting fixtures, light transformers and cable line. Roughly the quantities were: 130 metal and 337 wood standards, 327 precast concrete transformer vaults and

Fig. 3—Mount Vernon terminal, showing double-light cedar standards used at divided roadway and type of road sign.



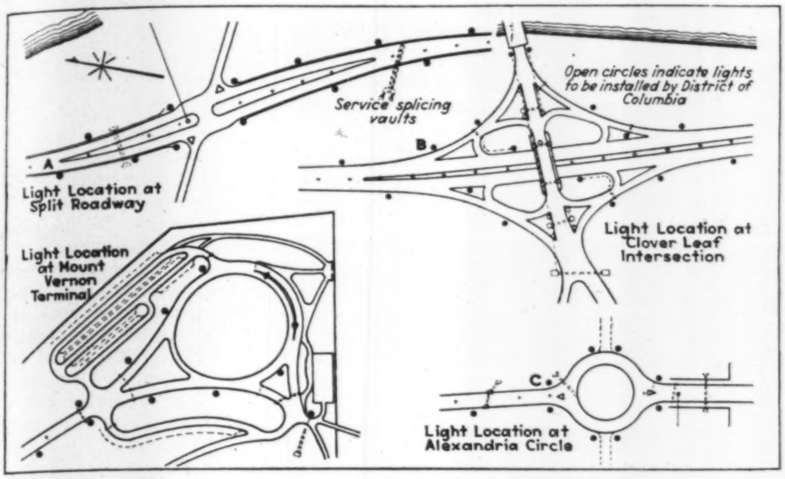

A
Light Location at Split Roadway
Service splicing vaults
B
Open circles indicate lights to be installed by District of Columbia
Light Location at Clover Leaf Intersection
Light Location at Mount Vernon Terminal
C
Light Location at Alexandria Circle

Fig. 4—Light locations at intersections, circle, terminal loop and other special roadway locations and arrangements.

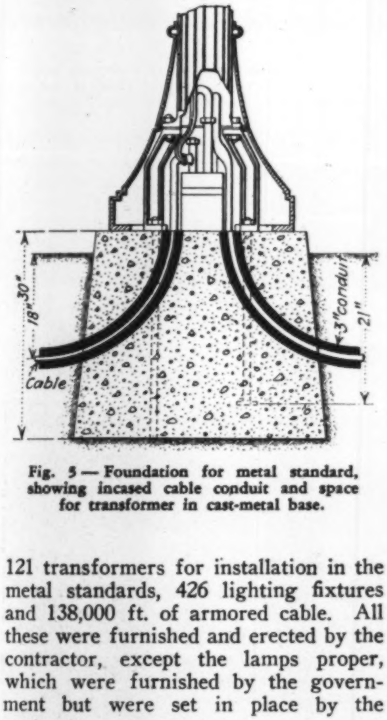

18"
30"
3" conduit
21"
Cable

Fig. 5 — Foundation for metal standard, showing incased cable conduit and space for transformer in cast-metal base.

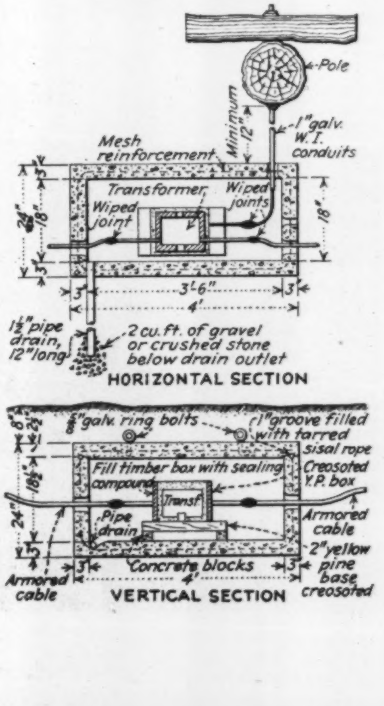
121 transformers for installation in the metal standards, 426 lighting fixtures and 138,000 ft. of armored cable. All these were furnished and erected by the contractor, except the lamps proper, which were furnished by the government but were set in place by the contractor.

Ground structures

The ground structures, consisting of the footings for metal standards, cable-line and transformer vaults, are interesting chiefly in the construction of the transformer vault and the cable conduits cast into the concrete base or footings. Fig. 5 shows the base with the embedded enameled conduits leading up to the transformer recess in the base of the metal standard. The separate transformer vaults are for the wood standards, and their construction is shown completely by Fig. 6. Their design and construction deserve notice for having been very carefully worked out. Virtually, the design is that of the Westchester County Park Commission of New York. The cable line is the standard armored cable laid in trench 18 in. deep. The cable carries a single No. 8 gage copper conductor wire.

The light standards are shown by Figs. 1, 2 and 3. The metal standards are on the road out of Washington to Alexandria, and beyond Alexandria cedar poles are used. The particular feature of the metal standards is the fluted pressed-steel shaft of No. 11 gage plate with one longitudinal weld. This shaft is welded to the upper cast-steel base casing, which in erection is bolted to the cast-iron base and transformer recess. These details are shown in Fig. 5. The design sought an attractive standard without excessive weight or cost. Except that the cedar poles were left unbarked, they conform to familiar standards.

Fig. 6—Separate transformer vault of precast concrete located underground at each cedar-pole light standard.


Pole
Minimum 12"
1" galv. W.I. conduits
Mesh reinforcement
Transformer
Wiped joints
Wiped joint
24"
18"
3"
3"
18"
3'-6"
3"
3"
4'
1½" pipe drain, 12" long
2 cu. ft. of gravel or crushed stone below drain outlet
HORIZONTAL SECTION
⅝" galv. ring bolts
1" groove filled with tarred sisal rope
8"
2½"
18½"
24"
Fill timber box with sealing compound
Creosoted Y.P. box
Transf.
Pipe drain
Armored cable
2" yellow pine base creosoted
Concrete blocks
3"
3"
4'
Armored cable
VERTICAL SECTION

The lighting system was designed and constructed under the direction of the Bureau of Public Roads, Thos. H. MacDonald, chief of bureau. The general contractor was the Westchester Electric Equipment Co., Yonkers, N. Y.

* * *

Estimating Groundwater Yield Similar to Reservoir Problem

The most urgent problems in the study of groundwater at present are those relating to the rate at which the rock formations will supply water to wells in specified areas. The permeable rock formations may be regarded as underground reservoirs or as undergound conduits. Some water-bearing formations function chiefly as reservoirs, others chiefly as conduits, but all of them have some of the properties of both. In attempting to solve the quantitative problems these two functions of rock formations must be recognized. The ways in which the problem of estimating available supplies of groundwater can be attacked are reviewed in water-supply paper 638-C, "Outline of Methods for Estimating Groundwater Supplies," by O. E. Meinzer, recently published by the United States Geological Survey.

The natural reservoirs formed by rock formations generally have very great capacity compared with that of ordinary artificial surface reservoirs. However, if the water derived from them is taken chiefly out of storage without being replaced, the supply will eventually fail. The safe yield of an underground reservoir, or the practicable rate of withdrawing water from it perennially, may be estimated by methods that are comparable to those used in estimating the safe yield of a surface reservoir, although different in technique. It is necessary to measure the rate of inflow or the rate of discharge, or else these rates must be estimated by determining changes in storage.

Groundwater travels laterally from the intake areas to the discharge areas. On account of the viscosity of water and the small size of the interstices of the material through which it usually percolates, there is a high resistance to its flow. Hence the rate of recharge is controlled not only by the intake facilities and the quantity of surface water that reaches the intake area but also by the capacity of the formation to carry water from the intake area to the area of natural discharge or to the wells where the water supply is to be recovered. If the distance from the intake area to the discharge area is great, as it is in some of the large artesian basins, the problem of safe yield relates to the capacity of the formation as a conduit rather than to its capacity as a reservoir.

Belt Conveyors Place Concrete for Vermunt Dam in the Alps

Using a no-slump concrete, placing was accomplished by belt conveyors that delivered a steady stream from mixers to form in thin layers that could be tamped without shovel distribution

By Bruno Widman

Dyckerhoff & Widman Aktien Gesellschaft, Wiesbaden-Biebrich, Germany

In Constructing the Vermunt dam high in the Alps in the western tip of Austria, concreting was a continuous process from the aggregate pits to the forms. A train of railway, aerial tramway, crushers, screens, batchers and mixers prepared the aggregate, introduced the cement and produced concrete in a continuous stream, which fed to a series of belt conveyors and tower hoists that reached directly into the forms. This plant produced and handled a concrete so dry that it registered practically no slump. Its operation was nearly automatic. The following article, by one of the constructors who built the dam, describes the methods and equipment employed and summarizes the lessons learned in operating belt conveyors for handling concrete. —Editor.

The Vermunt hydro-electric plant is the first unit in the development of 400,000 hp. that has been undertaken on the River Ill in the western tip of Austria, which lies between Germany and Switzerland. The builders are the Vorarlberger Illwerke Aktien Gesellschaft, and the plant will develop 125,000 hp. under a head of 2,257 ft. The diagram profile (Fig. 2) shows the general scheme of the plant and the cross-section and over-all dimensions of the dam. It has a volume of 188,000 cu.yd. The dam construction alone is considered in this article.

Structure and materials

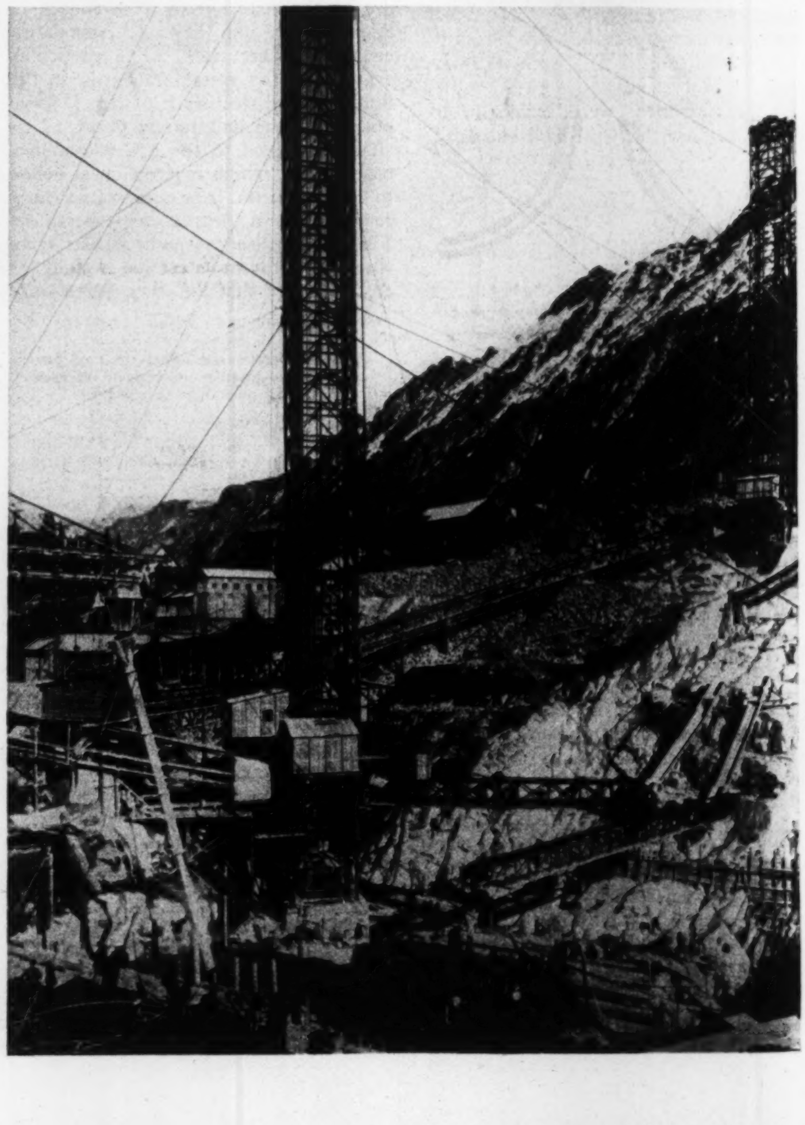
The structure of the dam is indicated clearly enough by the section in Fig. 2 and the plan in Fig. 3. It is a gravity dam concreted in blocks separated by across-dam planes. The faces to a depth of 6½ ft. are of richer concrete than is the main body. The total concrete, as stated, is 188,000 cu.yd., which is an increase of 32 per cent over the estimate on which the contract was let and which followed an increase in excavation. The volume of excavation was 57,000 cu.yd. of earth and 79,000 cu.yd. of rock, which were increases of 46 and 100 per cent, respectively, over the estimates. These increases, as noted later, affected materially the construction schedule.

The distinguishing feature of the concrete for the dam was the dry mixture employed. The theoretical basis for this was that better quality was secured. This gain was emphasized by economic considerations. To secure equal quality with a wet mixture, more cement must be used. In Europe the ratio of cement cost to wages for placing is much greater than in the United States; in central Europe the cost of 100 kg., or 220 lb., of cement is four to six times the hourly wage, while in America it is about the same. Saving of cement at the expense of labor is therefore profitable.

At the Vermunt dam there were other reasons for using a dry mixture. It reduced the volume of cement that had to be handled by the limited transportation facilities from the valley to the site of the dam. Again a dry and strong concrete reduced the frost hazard in a locality having at most a six months' working season. Finally dry concrete required less formwork, because it stood up well enough at construction joints, and because when forms were required they could be released sooner for re-use.

The concrete proportions for the bulk of the dam, or all but the outer 6½ ft. on both faces, was 15 kg. of cement per cubic meter, or roughly $\frac{2}{3}$ bbl. per cubic yard. The cement proportion was increased 50 per cent for the downstream facing and doubled for the upstream facing. Plastic mixtures were used for the facing. The aggregate was a river gravel with about 24.2 per cent by weight of clay and sand (3 per cent clay), 47.1 per cent gravel and 28.7 per cent oversize stone. Washing, crushing and screening were therefore necessary. Also the percentage of sand was too small, and more sand had to be produced artificially. This extra task,

Fig. 1—Towers and tower conveyors and vertical spouts are placing concrete continuously in thin layers for hand-tamping.



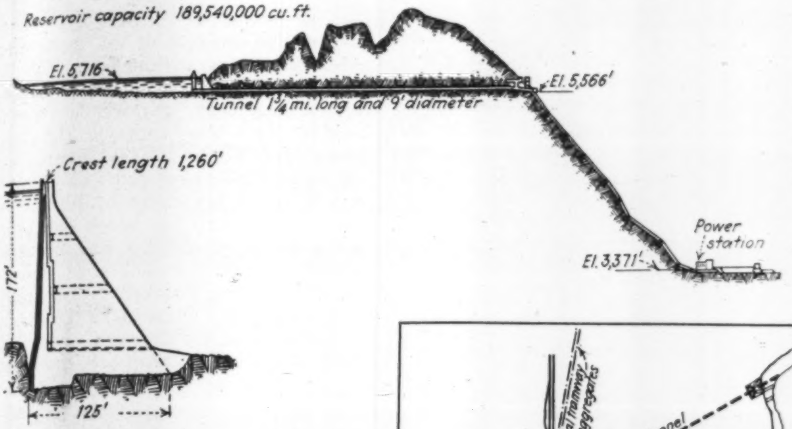

Reservoir capacity 189,540,000 cu.ft.
El. 5,716
Tunnel 1¼ mi. long and 9' diameter
El. 5,566'
Crest length 1,260'
172'
125'
Power station
El. 3,371'

Fig. 2—Schematic profile of Vermunt hydro-electric plant on the River Ill in western Austria.

which was not indicated by the preliminary studies, combined with the increase in quantities previously noted, upset the construction schedule that was originally planned.

Construction schedule

The time allowed for constructing the dam was three years. The actual working time, owing to six-months winters in these high altitudes, was eighteen months. The delay penalties were severe. Schedules were planned on original quantities of 147,000 cu.yd. of concrete, 40,000 cu.yd. of earth and 40,000 cu.yd. of rock. Also it was assumed that the preliminary findings of sand content in the gravel were correct. On these assumptions the contractors planned to complete the construction plant and the excavation in one working season and the dam concreting in the second season. With the increased quantities noted previously and the sand shortage, which required the reconstruction of the aggregate plant, the work was prolonged into the third year.

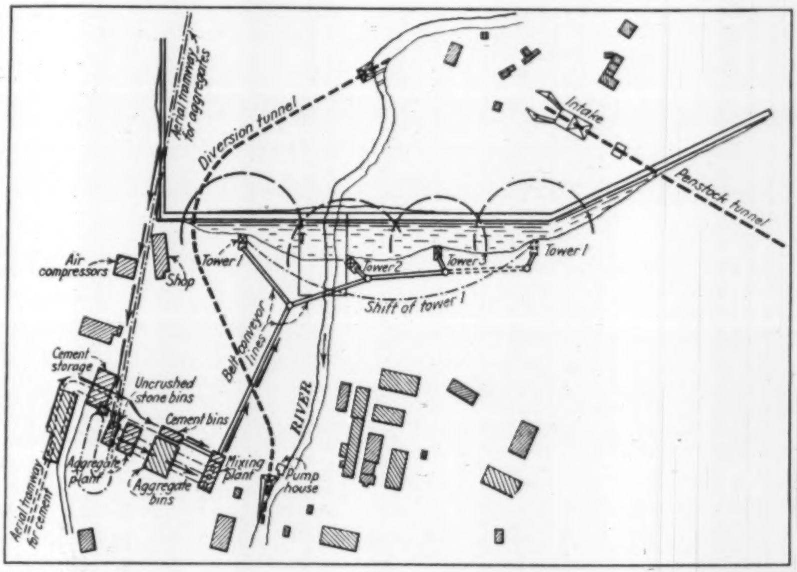

Aerial tramway for aggregates
Diversion tunnel
Intake
Penstock tunnel
Tower I
Tower 2
Tower 3
Tower I
Shift of tower I
Air compressors
Shop
Belt conveyor lines
Cement storage
Uncrushed stone bins
Cement bins
RIVER
Aggregate plant
Aggregate bins
Mixing plant
Pump house
Aerial tramway for cement

Fig. 3—Plan of Vermunt dam and of construction plant and camp; all buildings not named are workmen's houses and service buildings.

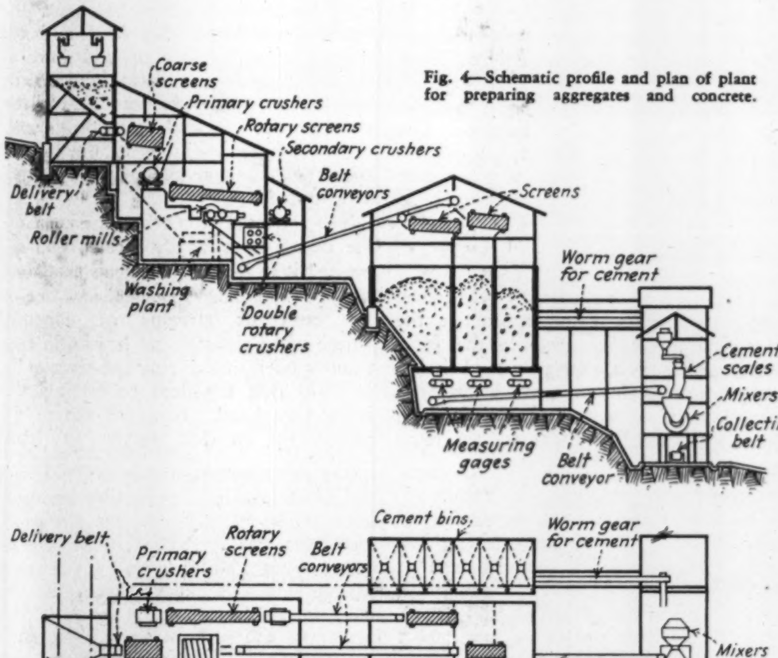

Coarse screens
Primary crushers
Rotary screens
Secondary crushers
Belt conveyors
Screens
Delivery belt
Roller mills
Washing plant
Double rotary crushers
Worm gear for cement
Cement scales
Mixers
Collecting belt
Measuring gages
Belt conveyor
Delivery belt
Primary crushers
Rotary screens
Belt conveyors
Cement bins
Worm gear for cement
Mixers
Belt conveyors
Raw gravel bins
Coarse screens
Washing plant
Secondary crushers
Screened gravel bins

Fig. 4—Schematic profile and plan of plant for preparing aggregates and concrete.

As indicating the accuracy of the preliminary planning on the basis assumed, it is mentioned that in the first season the plant was completed and 79,000 of the first estimated 80,000 cu.yd. of excavation was taken out. Had quantities and aggregates been as first estimated, the dam would have been completed in two years.

The general arrangement of the plant that was constructed at the dam site is shown by Fig. 3. In addition, the railway running up the River Ill was carried farther up the river to the location of the power station, at about 3,300 ft. elevation. From here an aerial tramway of 12 tons per hour capacity was carried about 3½ miles up the valley to the site of the dam at El. 5,740. This tramway was installed by the power company, and its terminal was at the cement house (Fig. 3). From his gravel pit upstream from the dam the contractor built a railway 2.85 miles and an aerial tramway 1½ miles to the terminal at the gravel storage (Fig. 3).

Concrete plant

The concrete plant is shown schematically by Fig. 4. Cement was delivered directly to the 660-ton cement bin by the aerial tramway from the railway terminus at the power station, and also to side storage for 790 tons. Chief interest lies in the handling of the aggregate. The raw gravel was delivered by the contractor's aerial tramway directly into a three-compartment raw-gravel bin. Incidentally it is noted that a triple parallel-unit arrangement prevailed throughout.

Three short belt conveyors capable of 40 per cent speed control fed the raw gravel to coarse screens that separated out the material up to 3 in. and dropped it into washers, from which it was carried to the main aggregate bins separated into sand and gravel. The oversize stone from the coarse screens was chuted to primary crushers that reduced it to 2⅜ in. and delivered it to the rotary screens. They screened off the sand and then the 1⅓- to 2⅜-in. material, which was dropped to roller mills. The oversize from the rotary screens went to secondary crushers and, after screening off the sand, to double-roller crushers. The crushed material then went to the main bins and was screened and deposited as sand and two sizes of coarse aggregate in separate bins. All the screening and sizing was controlled with care.

In batching, the aggregates were brought properly proportioned to the mixer-charging hoppers by belt conveyors, and the cement was brought to weighing hoppers by screw conveyors (Fig. 4). Larger schematic diagrams of the batching procedure are shown by Figs. 5 and 6. Particular attention was given to the method of taking off exact quantities of the aggregates. Instead of gates, plate conveyors (Fig. 5) were used. By regulation of speed, which was possible as close as fractions of a second, these drew off the exact amounts to within a variation of 1 per cent plus or minus. Fig. 5 gives the switch diagram for the remote control of the conveyors from the mixer. Fig. 6 is an assembly diagram of a complete batching unit. All operations were controlled by the mixer operators through a system of actuating switches and return signal lamps indicating the processes to be under way. The mixers were 1.3-cu.yd. machines and could handle 40 batches an hour.

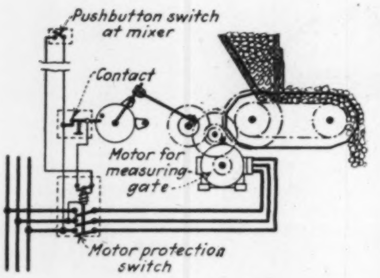


Fig. 5—Plate-conveyor aggregate-bin gate for taking exact quantity for a batch with electric control from the mixer.

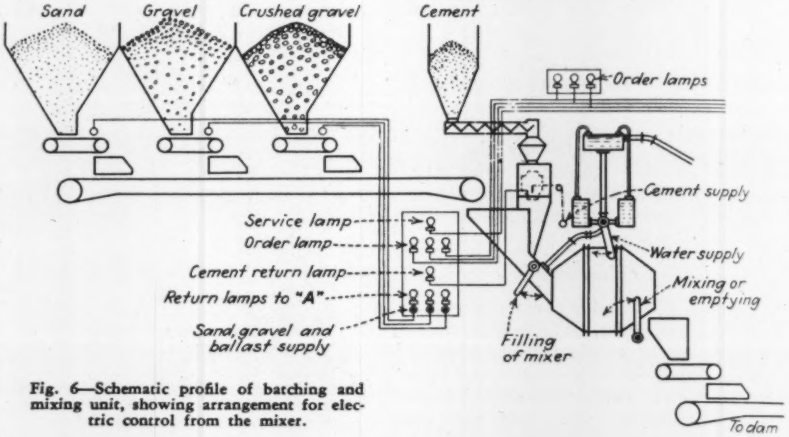


Fig. 6—Schematic profile of batching and mixing unit, showing arrangement for electric control from the mixer.

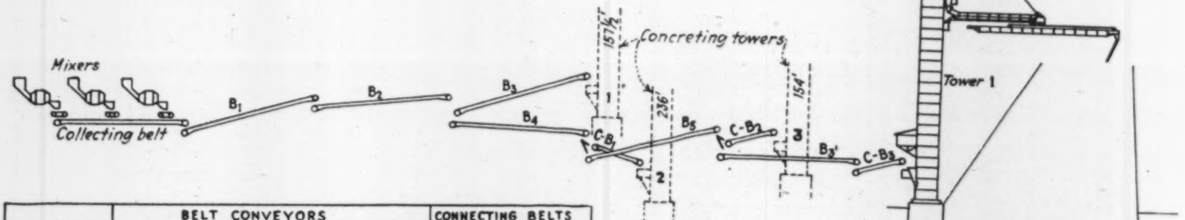
Constant testing of the aggregates for water content made it possible to adjust the water dosage with great accuracy. In fact constant control of all proportioning was insured by tests of the aggregates, particularly the sand, and finally by testing the concrete. The mean strengths of concrete, in pounds per square inch at 28 days, were: core concrete 2,318, downstream facing 3,436 and upstream facing 5,297.

Concrete handling

While the concrete plant as described did not go beyond common practice, the handling of the concrete to the form developed a belt conveyor and hoist-tower outfit that exceeded previous practice in extent and in volumes handled. Nearly 11,000 ft., or more than 2 miles, of belt-conveyor line carried the concrete to the three distributing towers indicated by Fig. 3. Fig. 7 is a schematic diagram of the belt arrangement, giving the tower heights and the conveyor lengths, grades and widths. These figures do not include the tower distributing conveyors, which are shown by Fig 8. In this arrangement the boom conveyor had a swing of 180 deg. and the suspended conveyor a full-circle swing. The suspended conveyor discharged into a swinging spout about 12 in. in diameter, with an outward swing of about 16½ ft. This, with a 59-ft. boom conveyor and a 46-ft. suspended conveyor, gave the tower conveyors a distributing radius of 121½ ft. The boom was arranged to slide up and down in the tower, and its operation and that of both tower conveyors was directed by an operator located on the boom. Fig. 1 is a view of one of the towers, showing the conveyor and spouting arrangement.

The conveyors took the concrete from the mixer in a steady stream and deposited it in 6- to 8-in. layers that were tamped by hand. Fig. 9 shows one of the conveyor streams of concrete. There were virtually no breaks in continuous operation during the six months in 1930 that the dam concreting was being completed. Some of the towers placed up to 182 cu.yd. an hour.

Fig. 7—Schematic profile of belt-conveyor system for distributing concrete from mixers to dam prism.



	BELT CONVEYORS						CONNECTING BELTS		
	B_1	B_2	B_3	B_4	B_5	B_3'	$C\text{-}B_1$	$C\text{-}B_2$	$C\text{-}B_3$
Length	164 ft.	164 ft.	164 ft.	164 ft.	164 ft.	164 ft.	32.8 ft.	32.8 ft.	46 ft.
Grade	15°1'	4°22'	15°54'	0°41'	13°18'	9°	14°29'	15°	12°
Belt Width	30 in.	30 in.	24 in	30 in.	30 in.	24 in.	24 in.	24 in.	24 in.

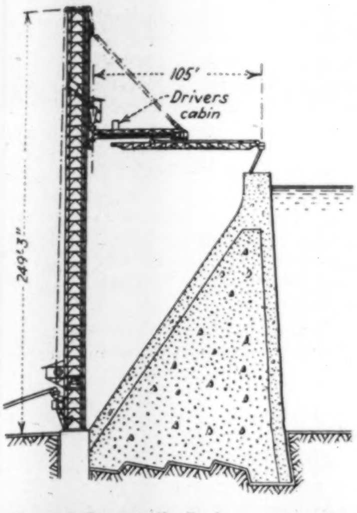


Fig. 8 — Concrete-distributing tower with swinging conveyors; three towers, with one shift of one tower, cover entire area of main dam.

Fig. 9—Belt conveyor carrying concrete. Note roof to protect concrete from sun and storms.

Other records were 2,548 cu.yd. placed in a twenty-hour working day, 37,180 cu.yd. placed in a month, and 118,300 cu.yd. placed in 85 successive working days.

Conveying technique

Successful belt conveying of concrete calls for a special technique. From experience at the Vermunt dam and other operations carried on by the contractor since 1925 the following lessons have been learned.

Particular care is necessary in carrying over the concrete stream from one belt to another or from the belt to other containers, and vice versa. It is often necessary, for example, where units discharge intermittently, to change the discharge to a continuous stream. At Vermunt it was possible that the three mixers might discharge their 5 cu.yd. within a period of 20 sec. To provide uniform feeding of the belt, each mixer discharged into a 1½-yd. bin from which a short belt conveyor led to the common collecting conveyor. Uniform flow at change points is, however, only part of the task, and the composition of the concrete must be kept unchanged. In general, the change must be a free drop without sliding or friction. This eliminates all methods employing chutes or tubes.

The conveyor design must be strong and enduring to handle the large volumes and withstand forced operation. Old-fashioned bushed bearings are preferable to the more refined antifriction types. All moving parts must be dustproof and accessible for easy lubrication during operation.

Rotary Drill Bores Holes for Timber Piles in Clay

Equipment similar to modern oil-drilling rig is used on new municipal auditorium at Long Beach, Calif.—Piles dropped into hole and driven last few feet—Test shows bearing capacity equal to driven piles

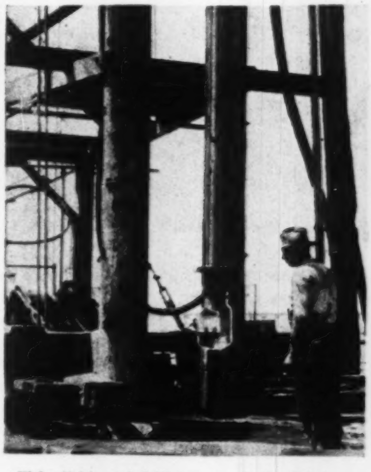
By Aaron J. Smith
Structural Engineer, Long Beach, Calif.

USING rotary drilling equipment similar to that used in oil-well operations, holes for timber piles to support the new municipal auditorium, Long Beach, Calif., were put through a stratum of hard clay that was extremely difficult to pierce by driving and jetting. The providing of drilled holes, except for the last few feet, which were driven, cut the time required for piledriving in two, and tests showed that the bearing capacity as between the two methods was not noticeably different. The building is located on an 8-acre area of hydraulic fill extending out into the harbor and inclosed by a timber sheetpile bulkhead on three sides. The filled area is, in turn, inclosed in a horseshoe-shaped pier and enrockment provided in an area of 32 acres of still-water lagoon for bathing and other recreational purposes.

The hydraulic fill varies in depth from 2 to 22 ft. and consists of fine sand and silt dredged from the bottom of the harbor. Support for the building consists of 1,749 untreated Douglas fir piles, varying in length from 36 to 44 ft., driven through this fill. The piles were driven in clusters of from three to 25 for the support of the building columns. Tops were driven to a depth of 9 ft. below surface of the fill by means of a follower that permitted cutoff about 1¼ ft. below permanent saturation point.

The original piledriving equipment consisted of two rigs with 5,000-lb. steam hammers and jetting equipment. Difficulties were experienced in penetrating a hard clay stratum underlying the original beach sand about 25 to 28 ft. below the top of the fill and varying in thickness from 1 to 17 ft. Even with the aid of jets, this layer presented such difficulties in driving that it became advisable to develop a different method to facilitate the work.

The subcontractor for the piling work evolved a novel scheme, which, in the experience of the writer, is a new departure in piledriving operations. Each of the driving rigs was equipped with



Fishtail bit and drill stem ready for drilling. Rotary table moves out from leads to engage stem.

Connecting-slip driving collar of rotary table with drill stem.

a small rotary table, similar to the rotary table on the modern oil-well drilling rig, and a small steam engine that was supplied from the main boiler and geared to the rotary table. In addition, a small hoist drum was added to handle this equipment. The drilling mechanism was arranged to slide between the sills of the rig, so that it could be moved either out over the location stake or back out of the leads.

The rotary table was equipped with a slip driving collar gripping the drill stem, which was tipped with a 12-in. fishtail bit. The drill stem had a swivel suspension head and high-pressure water-hose connection. This head was suspended over the head blocks of the rig with wire rope leading to the hoist drum on the engine. A high-pressure water hose connected to the head, supplying water through the stem to the drill, completed the special equipment.

Piles for the foundation of the large auditorium at this Long Beach, Calif., recreational center were put down in holes drilled with rotary equipment through a stratum of hard clay.

With this rotary drilling equipment it was possible to bore a hole through the hard clay stratum to within a few feet of the final location of the pile tip, pull the drill, move the table back from the leads and drop the pile into the hole before the sand had a chance to refill the hole. The driving of the pile the last 6 or 8 ft. was comparatively easy, although there was a tendency for the pile to float if the load of the follower and hammer was not applied at once. The entire operation by this method required less than one-half of the time previously used in driving the pile to the same depth. In some cases it was necessary to use the jet for the sand at the bottom of the hole, but even with this extra jetting the time saved was almost one-half that previously consumed. The average number of piles driven per day per rig after installation of the drilling equipment was 25, as compared to ten by the other method.

A load test of the drilled piles was made, for comparison with former tests made on the jetted piles, by applying a load of 59.5 tons, or slightly more than twice the design load of the structure. There was no appreciable difference in the load-bearing capacity of this pile and those formerly tested, which were driven for the entire depth. Settlement amounted to about ⅛ in., and recovery was complete with removal of the load.

As the elevation of the top of the fill was at +12 ft. and the cutoff was at +3 ft., which is about 1.25 ft. below permanent saturation, it was some time before the butts of the piles were uncovered and the exact location determined. The clusters put down by the drilling method were found to be more nearly in proper position than those driven with the aid of the jet. The designed load for each pile was 25 tons, and each cluster was accurately surveyed to allow recalculation of its center of gravity in relation to the superimposed column. In any case where sufficient eccentricity existed to cause an overload exceeding 5,000 lb. on any one pile, extra piles were driven to bring the load to the design figure. This entailed an endless amount of engineering work on the job, a redesign of the pile caps being required on every cluster that was corrected. The driving of the additional piles was done with a 3,300-lb. drop hammer, as the heavy steam rig was too unwieldy to be moved around without extensive falsework.

Excavation by the open-ditch method, using a dragline, proceeded as fast as possible behind the driving of the piles. The fill was removed to El. 2.5, from which elevation the concrete work started for the capping of the piles. The unwatering of the excavation was not difficult, but the sand and silt at this elevation were very soft. To provide a satisfactory method for placing steel and concrete on this soft bottom, the excavation was continued to El. 2.16, and a 4-in. layer of concrete was poured in a form to seal the bottom of the excavation. This mat of concrete was slightly larger than the cap, allowing sufficient room to place the forms for the cap proper on the edge of the mat. The water was pumped to the bottom of the mat, and all work was done in the dry. The water was kept down until the concrete had set for at least 24 hours.

During this time there was a delay of several weeks, the pumps were shut off, and the water was allowed to fill the excavations and cover some mats that had been poured for only a short time. Upon unwatering and inspecting these mats it was found that peculiar lime-like growths appeared on the mats. These formations looked like small twigs about ⅛ in. in diameter and 4 to 5 in. long.

After the 246 footings had been completed and the steel and concrete superstructure had advanced out of the way, a system of concrete walls and struts was added to provide lateral stability to the foundation in case of earthquakes.

R. E. Campbell, Los Angeles, was general contractor, with the Pan-Pacific Piling and Construction Co. as subcontractor for the driving of the piles. W. Horace Austin was resident architect, with the writer as supervising engineer in charge of construction.

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Yokohama Reclaims Sea Bottom

Reclamation of 510 acres of land built up from the ocean bottom in the industrial district of Yokohama, Japan, is nearing completion. The area, when completed, is to be used for factory-site and freight-handling facilities. The work was financed by a municipal bond issue offered in 1926.

Curious Old Timber Viaducts, Great Western Railway, England

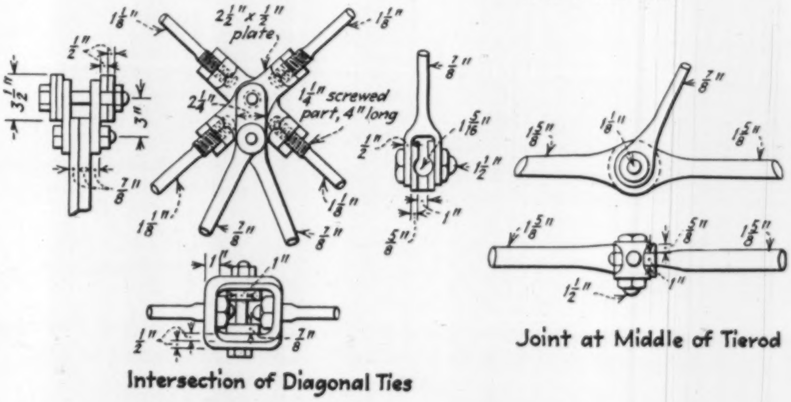
Timber struts radiating fan-shape from tall masonry piers carry built-up stringers for 66-ft. spans—Complicated ironwork details

TIMBER viaducts, about 80 years old, on the Great Western Railway, England, which are to be renewed this years, are the last of a series of 52 remarkable structures designed and built under Isambard Brunel, chief engineer of the railroad during its early promotion and construction period. Of 52 single-track timber viaducts on the extreme western portion of the line, in Cornwall, the last remaining three are about to be replaced. These are on the 65-mile branch from Plymouth to Falmouth, which had originally 42 of the timber viaducts, while there were ten on the 26 miles of main line between Truro and Penzance. In both cases the railroad crosses a succession of valleys that were too deep for economical embankment filling. A typical viaduct is shown in Fig. 1.

The present three structures are as follows: (1) the Collegewood viaduct, 954 ft. long and 100 ft. high, to be replaced with a double-track viaduct 920 ft. long, having stone piers, brick arch spans and concrete parapet walls; (2) the Carnon viaduct, 556 ft. long and 110 ft. high, to be replaced with a single-track structure having stone piers, brick arches of 68-ft. span and concrete parapet walls; (3) the Ringwell viaduct, 366 ft. long and 75 ft. high, being replaced with a single-track embankment having a 6-ft. masonry culvert for the stream. The amount of timber in the original structures was 17,200 cu.ft. for the Collegewood, 13,500 cu.ft. for the Carnon and 6,500 cu.ft. for the Ringwell viaduct.

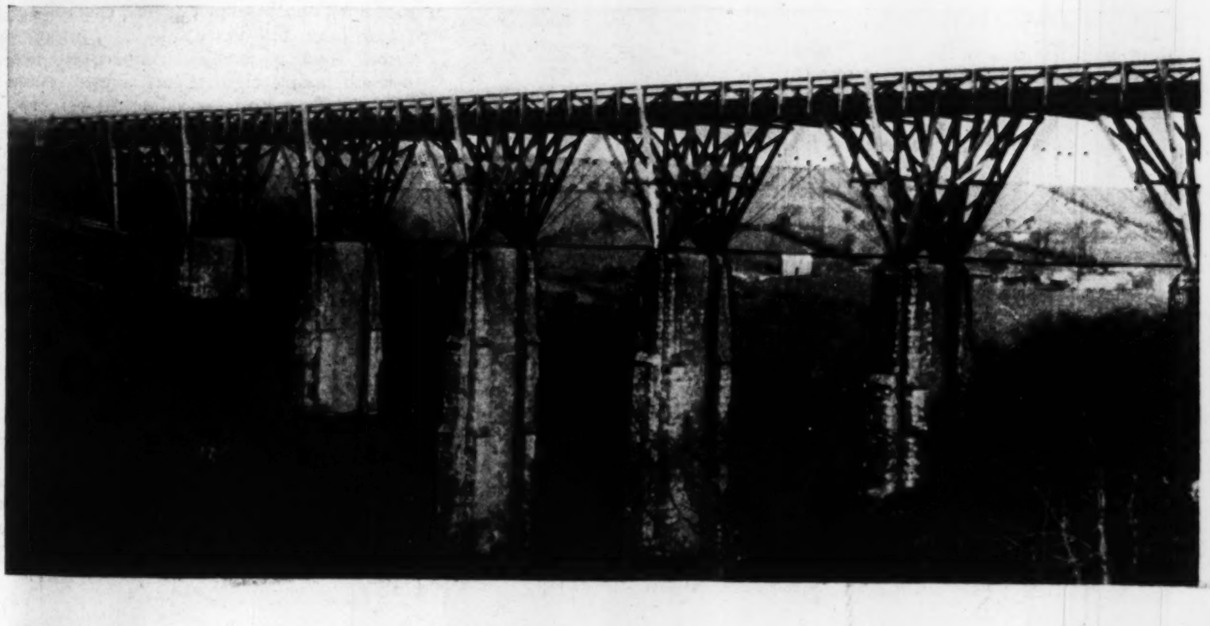
These old viaducts were mainly of two types. In the first type, stone piers, 60 to 66 ft. apart and with a maximum height of about 100 ft., extended to about 20 or 35 ft. below rail level. From the tops of the piers timber struts radiated in fan-shape and supported stringers on which the solid timber deck was carried, 15 to 16½ ft. wide. For some of the viaducts there were three parallel sets of struts carrying three lines of stringers, while in others there were two sets of struts in a vertical plane, and between them were two raking legs or inclined A-frames supporting the center line of stringers. Swaybracing was fitted between the struts or legs, while transverse struts or wales were laid against them and notched into them. In the other type of viaduct, used in crossing tidal creeks that had some 70 ft. of mud bottom where suitable foundations could not be made for stone piers, tapering piers were built of timber piles and 24x24-in. posts with braced panels. Upon these piers were carried timber half-through shallow trusses of about 60-ft. span and 15-ft. depth. In the highest masonry piers the middle curtain wall was pierced with openings in order to reduce the weight.

Fig. 2—Ironwork details of timber bridges 70 to 80 years old.



Standardization was not known in those days, and nearly every structure had its own modifications or variations. But all the viaducts were so designed as to permit of replacing any individual timber with little trouble or interference with traffic. Fir timber of slow growth

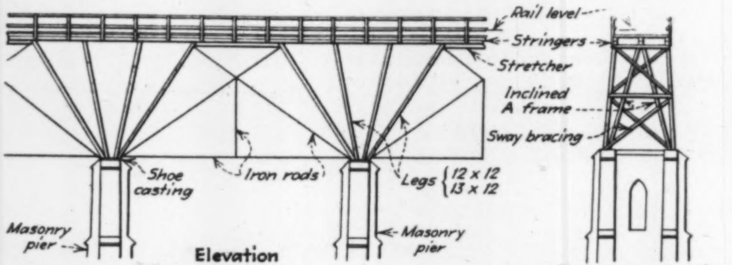
Fig. 1—Ponsanooth viaduct, England, has 66-ft. spans with timbers in fan-shape supporting stringers.

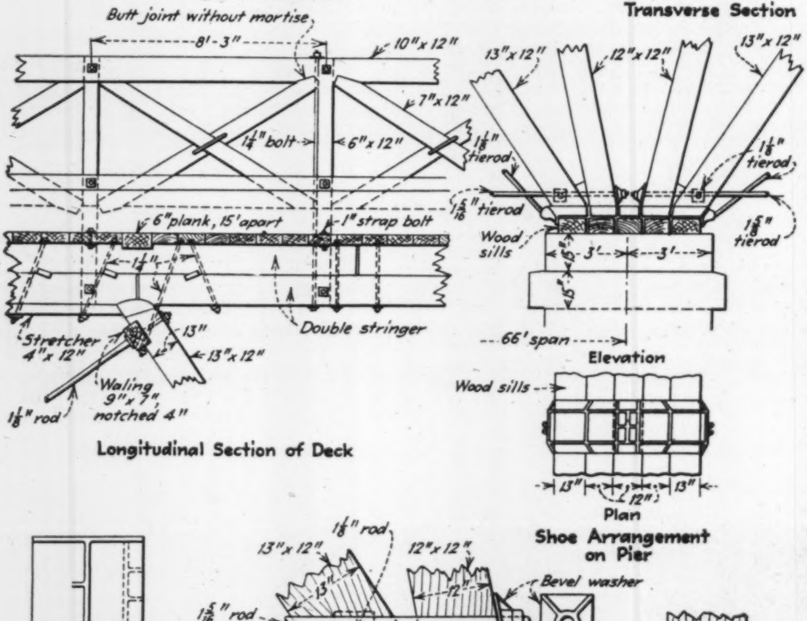


and great density, from the Baltic region, was used in the original construction, and the sticks were kyanized mainly as a protection against fire rather than for preservation. It is stated that none of the structures suffered damage by fire. Some of the old timbers lasted 60 years or more. In modern repair work Quebec pine and Oregon pine were used, but they had a relatively short life. The struts or legs showed decay first at the shoe castings on the piers and then at the bolt holes.

In the St. Pinnock viaduct (Fig. 3), which is typical of the three structures now being renewed, the spans were about 66 ft. c. to c. of piers, and the distance from top of pier to rail level was about 35 ft. Two parallel sets of struts or legs, 12x12 in. and 12x13 in., with A-frame inclined legs between them, carried three lines of stringers, each consisting of two superimposed timbers, 12x12 in. or 14x12 in., fastened together by vertical and diagonal bolts and iron keys. Across these were laid the 4-in. deck planks, supplemented by 6-in. planks at 15-ft. intervals, these latter being dapped over the stringers. Longitudinal timbers on the deck carried the track rails, and substantial trussed parapets were provided, bolted through the stringers. In each span a stretcher timber under the stringers was fitted between the ends of the outer struts, as shown in the drawings reproduced herewith.

Fig. 3 — Pinnock viaduct, replaced some years ago, is typical of 52 timber structures, the last three of which are being replaced this year.


Rail level
Stringers
Stretcher
Inclined A frame
Sway bracing
Shoe casting
Iron rods
Legs {12 x 12 / 13 x 12
Masonry pier
Masonry pier
Elevation
Transverse Section


Butt joint without mortise
8'-3"
10"x 12"
7"x 12"
1¼" bolt
6"x 12"
6" plank, 15' apart
1" strap bolt
1½"
Stretcher 4"x 12"
13"
13"x 12"
Waling 9"x 7" notched 4"
1⅛" rod
Double stringer
Longitudinal Section of Deck
13"x 12"
12"x 12"
13"x 12"
1⅛" tierod
1⅛" tierod
1 5/16" tierod
1⅝" tierod
Wood sills
3'
3'
66' span
Elevation
Wood sills
13"
12"
13"
Plan
Shoe Arrangement on Pier
Stringer
½"
Drain holes
12"
Stretcher
13"
1¼" bolt
1¼" pin, eye of jam ⅝"x ⅝"
Leg timber 13"x 12"
Whale 9"x 7", notched 4"
Eye of bolt ¾"x 1⅛"
Detail at Head of Leg Timber
13"x 12"
1⅛" rod
12"x 12"
Bevel washer
1 5/16" rod
Connection for 1⅛" diagonal rod
2½"
Drain holes
Elevation of Shoe
1" bolt, screwed both ends
3"
12"
3"
2½"
¾"
Plan of Shoe

Shoes and Fastening for Radial Timber Legs

A large amount of special ironwork was required in assembling the timber framing. Filler plates were placed between the joints of stringers, and castings at the heads of the struts served also as seats for the stretchers. Shoe castings for the struts were seated on 6x12-in. sills laid across the top of the pier. Furthermore, in each span horizontal 1⅝-in. tierods with bevel washers connected the legs, while 1⅛-in. diagonal rods led from the shoes to the top ends of the legs. From the intersection of these diagonal rods a vertical hanger extended to a connection with the horizontal tierod. These rod connections required ingenious and rather complicated details, as indicated in Fig. 2.

Plans and particulars of these interesting structures have been furnished by Raymond Carpmael, chief engineer, Great Western Railway, and H. S. B. Whitley, division engineer.

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Studies of Continuity by Welding

With the cooperation of the University of Toronto, the National Research Council of Canada has been conducting an investigation into the continuity of welded steel beams. While the experimental results thus far obtained in this study must be extended and confirmed, it has been shown that where two beams are connected to the column flanges, either of the welded connections is markedly more rigid than the riveted T connection for all loads up to the safe capacity of the beams. Connections of beams to the column web show little difference in rigidity of loads up to about 25 per cent of the safe load; but above this load, for normal loading, welded connections are much more rigid than riveted ones, while for a load exceeding 50 per cent of the safe load, welded connections are more rigid than riveted ones for either normal or reversed loading.

Because of the incidental stiffening effect of the material welded to the beam flanges in welded connections to a column web, the positive moment at mid-span of the beam is advantageously reduced to an amount below that for a perfectly restrained uniform beam. It has been shown that column-flange distortion reduces the restraint obtained with conventional riveted and welded connections, and, according to the report issued by the National Research Council, designers may find the use of diaphragms between column flanges both practicable and economical in cases where a high coefficient of restraint is desirable.

The Great Flood of the Yangtse River

Range and height of inundation, with calculation of heights, assuming a retained river, and some recommendations for immediate palliative measures and ultimate remedy

By Ludwig Brandt

Member Chinese Flood Relief Commission, Vienna, Austria

Dispatches from Hankow indicate the early stages of the summer highwater in the Yangtse River to be greater than normal and presaging, should the rains continue, a possible repetition of the flood of 1931. This flood covered an area of 47,000 square miles and drove 10,500,000 people from their homes. The Mississippi River flood of 1927 inundated less than half this area, and about 600,000 persons were temporarily dispossessed of their houses and lands. In the following article an engineer who speaks with the authority of membership in the flood relief commission tells of the rise and the extent of the Chinese flood and presents computations indicating a plan of protection embracing diversion channels, storage reservoirs and channel regulation. As an account of one of the greatest inundations of history the article commands attention. —Editor.

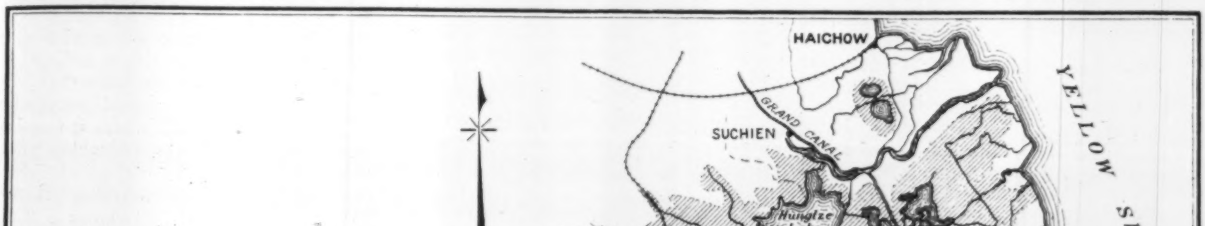
The Yangtse Kiang, the great alluvial river of China, has an annual high-water period that reaches its higher stages in July and August. These flood waves have a duration of several weeks, or even months in the middle and lower reaches of the stream. In Ichang, about 1,073 miles from the mouth, two or three crests generally follow at brief intervals during July and August; these each last only a week or fortnight. At Hankow, about 400 miles nearer the river month, these separate crests have become merged in a single wave of several months' duration. With crest heights of 45 to 48 ft. at Ichang, the corresponding stages at Hankow are 40 to 41 ft. This normal high-water regimen was increased to quite extraordinary heights and duration in 1931.

Rise of flood

In the first few days of July a heavy rainfall began over the entire middle and lower valleys of the Yangtse. On several days and in several places the downpour reached 5 to 6 in. in 24 hours. A second rainy period followed, so that at Hankow in 21 successive rainy days in July a total of 21½ in. of rain fell, which was about 43 per cent of the average annual rainfall. The severity of the downpour decreased from east to west, or, in other words, upstream; but at Ichang it was 14 in. in July, which was 32.6 per cent of the average annual precipitation.

Rains continued throughout August, but not with such intensities as in July. Yet in several places in the middle and upper reaches the daily downfall reached 4 in., and in Ichang the total for the month was about 12⅓ in. A considerable volume of the August rains fell on land water soaked by previous rains, and the runoff was rapid. This was also intensified by the lack of normal storage in the numerous lakes already filled to overflowing. As a result, river levels rose rapidly, broke the levees, and the stored overflow prolonged the period of high stages.

At Ichang the flood reached its peak on Aug. 10 with a stage of 50.3 ft., and at Hankow the peak was on Aug. 19 with a stage of 53.6 ft., or 5½ ft. above bank level. These levels would have been considerably greater had not the levees above Hankow been breached or


HAICHOW
YELLOW SEA
GRAND CANAL
SUCHIEN
Hungtze Lake
PENGPU
HWAI RIVER
YANGCHOW
CHINKIANG
NANKING
RIVER
YANGTSE
Chaohu Lake
WUHU
SOOCHOW
Taihu Lake
SHANGHAI
HAN RIVER
ICHANG
SHASI
YANGTSE
TSIENKIANG
HANKOW
HWANGCHOW
ANKING
TSINGSHIH
RIVER
KIUKIANG
CHENGLINGKI
YOCHOW
LAISHIHSHAN
CHANGTEH
Poyang Lake
YIYANG
NANCHANG
CHANGSHA
LEGEND
Railway
Area flooded seriously
Scale of Miles
0
50
100
150

The 1931 flood of the Yangtse Kiang in China inundated an area of 47,000 square miles and drove more than 10,000,000 people from their homes.

overtopped, thus cutting down the crests. An overflow area from 60 to 90 miles wide formed in the Tung Tin Lake district, and another formed on the north bank of the river, extending a width of about 60 miles from Chenlingki to Hankow. The discharge of these immense reservoirs produced high stages at Hankow long after low stages had been reached in the upper river and its tributaries. For two months from July 23 to Sept. 23 the water was overbank at Hankow.

Flood damage

This duration of the flood increased the damage. As a part of the relief work, airplane surveys and, in places, photographs of the flooded districts along the Yangtse Kiang were made from Nanking to Ichang by the central survey office of Nanking, and in the eastern district along the Grand Canal by Colonel Lindbergh, who put his services at the disposal of the flood relief commission on his visit by airplane to the Far East. The airplane surveys disclosed 34,000 square miles of inundated land, not including the lake areas of 9,000 square miles. The flooded areas not first covered, but which were finally surveyed, brought the total to 47,000 square miles of territory flooded.

Further figures from an economic survey made by the department of agricultural economics of the University of Nanking disclosed the following flood effects: A total of 90 districts and 266 villages was investigated. The farm population affected about equaled the total farm population of the United States. About 45 per cent of all the farm buildings in the flooded area was destroyed, and four-tenths of the population was compelled to emigrate for some months. The average maximum depth of water on the fields was 9 ft. The total loss is calculated at about $500,000,000, represented by crops, live stock, buildings, implements, stored grain and household goods. The population affected was 50,000,000, of which 10,500,000 were made homeless and had to live on relief funds. About 2,790 miles of levees has to be repaired, requiring about 273,500,000 cu.yd. of earthwork.

Emergency engineering

As soon as the flood had sunk between levees the urgent problems were: (1) to drain the floodwaters from Hankow, and (2) to prevent reflooding by a backwater breach of the levee behind the city as the river level subsided. These problems were solved by breaching the levees artificially. The next immediate step was the repair of levees. This was made an opportunity for relief work by employing about 650,000 of the sufferers from flood at a wage of wheat and flour for themselves and families.

STAGES OF 1931 FLOOD ON THE YANGTSE KIANG CONTRASTED WITH COMPUTED STAGES, HAD THE WATER BEEN HELD BETWEEN THE LEVEES.

	Recorded Stages, Ft.	Calculated Stages, Ft.	Difference, Ft.
Ichang	50	50	Zero
Yochow	51	54.9	3.9
Hankow	53.6	57	3.4
Kiukiang	45.4	48	2.6
Wuhu	31.3	33	1.7
Nanking	25	26.7	1.7
Chinkiang	20.1	22.6	2.5

The major problem was to lay down in quick order a plan to serve as a foundation for undertaking systematic measures looking toward protection from future floods. For this step the first task was to determine the highest flood levels to be expected if all the flow is to be carried between levees. It was obvious that in 1931 the river stages had been modified by the levee breaks and the flooding of large areas outside the levees. It was necessary then to reconstruct the water stages, assuming that the levees had not broken. This was complicated by the complex influx conditions of the Yangtse and by the numerous lakes on its banks that act as reservoirs. Finally the records were very scant, particularly in respect to certain important and deciding influents such as the Han with its mouth near Hankow.

The plan adopted was the reconstruction of the flood by combining in different ways the high-water stages of the various influxes, Hankow being selected as the locality particularly characterizing the extent of the flood. The results of the studies may be briefly summarized as follows:

Computed flood stages

1. Combination of the high-water wave of the Yangtse Kiang at Chenlingki with that of Tung Tin Lake at Laishishan, and the application of this combination to the actual readings of the gages at Hankow. This computation gave a stage of 55 ft. at Hankow, or 1.4 ft. more than the actual gage reading. A possible and a more unfavorable condition could have given a stage of 55.5 ft.

2. Combination of the gage readings at Ichang, Laishishan and Chenlingki, and its application to the gage readings at Hankow. This combination gave an average normal stage of 56 ft. at Hankow, and 57.1 ft. for the most unfavorable condition.

3. Combination of the gage readings at Ichang, Tsingshi, Chengteh, Yiyang and Changsha with Chenlingki, and its application to the gage readings at Hankow. This computation gave at Hankow a normal stage of 56.7 ft., and 57.4 ft. under the most unfavorable conditions.

From the three combinations it seems reasonable to assume a flood stage at Hankow of 57 ft., had the water been held between the levees. From a crest of 57 ft. at Hankow the presumable crests at other points along the river can be computed by correlation of the gage readings. In the accompanying table the possible stages are contrasted with the gage readings of the 1931 floods at seven points. The figures show that extensive measures are necessary to give protection from a flood as great as that of 1931.

Diversion plan

It is not possible to raise the levees to hold the water throughout the length of the river. At several places the cross-section is too small to carry the flow without extraordinary levee heights for long distances. Again, raising the levees is not easy at towns along the banks where buildings occupy the present levee tops. At Hankow also the cross-section is in places too narrow. At other points the channel is restricted by hills, and enlargement would involve extraordinary difficulties and costs.

These conditions indicate that a plan for flood protection requires study of diversion channels and storage reservoirs. The numerous lakes along the river offer opportunities for reservoirs, and other possibilities exist along the upper river. Diversion has to be studied, especially in relation to the protection of Hankow, to relieve the demands on the narrow places in the cross-section and for the protection of Kiukiang and Nankin.

Financial conditions preclude undertaking at once the plan for full protection, but a beginning of regulation is possible in the districts most afflicted by floods. This work can take the form of increasing flow-off and prevention of deposits of sediment where it restricts flow. It would be possible also gradually to stabilize the channel width and depth to improve navigation and increase highwater discharge. This would require regulating works at necessary places.

Such gradual control measures call for a permanent supervisory service for directing work, recording river stages and predicting water levels.

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Forest-Fire Losses Decrease

Acreage of timberland in the national forests destroyed by fire during the first half of this year was 46 per cent less than that for the same period in 1931. Altogether 51,514 acres was burned, compared to 96,228 acres during the first half of last year. An improvement in climatic conditions and a decrease in the number of man-caused fires have contributed to the reduction. Officers of the forest service, Department of Agriculture, believe that new roads, trails and equipment and improved technique, based on the experience of past years, will continue to improve the fire-suppression record.

Forecasting Snow Runoff of Humboldt River, Nevada

Peculiar conditions of this river required long study to develop formulas producing reliable results

SNOW SURVEYS and forecasts of stream runoff from snow fields constitute a special feature in hydraulic investigation that has proved of immense advantage to interests utilizing streams fed by great snow fields. With long experience the cooperative Nevada-California snow survey organization has developed methods and forecasting calculations that are proved to give highly accurate estimates of runoff and flow of streams heading in the ranges of the Sierra Nevada. Less extensive work has been done in Maine and Alaska, and a snow-survey system is about to be started by the state electricity commission of Victoria, Australia. The present article outlines the difficulties experienced with a snow-fed river in Nevada whose conditions differ so far from those of other streams in the same region that accurate forecasting seemed at first to be impracticable. Continued study, however, appears to have brought these conditions under control and to promise the establishment of formulas and forecasts as reliable as those for other streams —EDITOR.

THE ANNUAL forecasting of streamflow or runoff from mountain snowfields, with information as to the prospective supply for irrigation, power and domestic uses, is an important engineering work initiated in Nevada some years ago and now operated in conjunction with California. This forecasting system has been described at different times, and a review of the California snow survey and 1932 forecast was given in *Engineering News-Record* of April 14, 1932, p. 559. A high degree of reliability has been attained for streams on both the eastern and western slopes of the Sierra Nevada. But the Humboldt River, with its annual flow varying from 8 to 268 per cent of normal, has been an exception, the methods found successful with other streams failing to give correct results under the peculiar conditions of the Humboldt. These conditions and the possible development of a reliable forecasting method for this stream have been reviewed in a recent report by J. E. Church, adviser for the Nevada cooperative snow surveys and meteorologist of the Nevada state agricultural experiment station.

The Humboldt River, rising in the ranges of the northeast portion of Nevada, has a circuitous course of nearly 1,000 miles west and south, discharging finally into the Humboldt Lake, which has no outlet and is a part of the desert known as the Humboldt and Carson Sink. For forecasting purposes it is divided into the upper and lower basins, with divisions at Palisade, the point of greatest volume of flow. It is fed mainly at its head, six feeders furnishing 90 per cent of the flow at Palisade. In the upper basin the gradient is about 10 ft. per mile, while that of the feeders varies from 12 to 50 ft. per mile. The gradient of the lower basin is 4.8 ft. per mile. Precipitation and temperature stations have been maintained since 1870 by the U. S. Weather Bureau, and stream gaging was begun in 1896.

While all records are fragmentary, Prof. H. P. Boardman, University of Nevada, has established a monthly record for Palisade, beginning with the water year 1903-1904. He has also established a 24-year monthly and yearly normal flow, based upon the records of the U. S. Geological Survey. A summary of the record is given in the accompanying table, but all the records are affected by large diversions, and the flow does not correspond with the snow cover, as in streams having drainage areas in the Sierra Nevada. For the 28 years covered by the table the annual runoff at Palisade was 90 to 110 per cent of normal in five years, below 90 per cent in sixteen years and above 110 per cent in seven years.

Snow surveys in the Humboldt basin, begun in 1918, have been supported by small appropriations from the state and by funds raised by the irrigation districts and power companies. At first the forecasts were so unsuccessful that the work would have been abandoned except for the practically complete success in forecasting streamflow in the Sierra Nevada basins and in forecasting the rise and fall in Lake Tahoe.

There are two essential flows each season: February-March from the bench lands between El. 5,500 and 6,500, and April-July from the higher levels of two ranges on the north and south. These ranges are 75 miles apart and may have a widely different seasonal snow cover. For the five-month March-July runoff at Palisade the normal monthly distribution is 16, 22.1, 24.8, 27.1 and 10 per cent, respectively.

Owing to the character of the streambed and diversions, the Humboldt tends to "flash" upward in seasons of heavy snow and downward with snow cover below normal. Throughout the 28 years of record (noted in the accompanying table, which is summarized from the report) dry periods have never exceeded three years until the present period, which lasted four years (including 1930-1931) but has now finally closed.

The Humboldt is not subject to the runoff law that prevails in the Sierra Nevada—namely, that the seasonal percentage of the snow cover, or its percentage of normal cover, will determine closely the runoff of the tributary streams. In thirteen years of snow surveys on this river only once was the runoff within 10 per cent of the snow cover, and in only four years was it within 25 per cent, while in one year the runoff was double the percentage of the snow. This condition is not due to shallowness of the snow cover, as was supposed, but is found rather to be due to the character of the channel and the extent of summer precipitation.

Snow Surveys for Runoff Forecasts, Published in *Engineering News-Record*

Snow Records in California	**April 14, 1932**
Snow Survey for Runoff in New York	**Jan. 8, 1931**
High Density of Snow, by J. E. Church	**Oct. 6, 1927**
Snow Surveys in the Sierra Nevada	**July 1, 1926**
Precipitation and Runoff at the Continental Divide, by Church, Jones and Boardman	**Jan. 29, 1925**
Snow Density and Runoff (report by Church)	**Feb. 7, 1924**
Snow Survey and Forecast (report by Church)	**May 15, 1924**
Snow Survey and Forecast (report by Church)	**June 7, 1923**
Snow Surveys and Floods in Maine	**May 17, 1923**
Snow Surveying and Forecasting, by J. E. Church—	
I	**Feb. 10, 1921**
II	**Feb. 17, 1921**
Snow Survey on Spokane River	**Feb. 3, 1921**
Determination of Water Supply From Snow Fields (*Engineering News*)	**Oct. 23, 1919**
Snow Survey for Predicting Streamflow, by J. C. Alter (*Engineering News*)	**May 29, 1913**

The most potent secondary factor in forecasting the streamflow of the Humboldt is the relative moisture in the soil of the channel, every 10 per cent variation above or below the normal snow cover being attended by a 20 per cent variation in streamflow. Thus 110 per cent snow cover gives 120 per cent runoff, while a 60 per cent cover gives only 20 per cent runoff. This phenomenon

HUMBOLDT RIVER SEASONAL RUNOFF

	Minimum			Maximum			
	Year	Acre-Feet	Per Cent of Normal	Year	Acre-Feet	Per Cent of Normal	Norma Acre-Feet
October	1919–20	1,190	....	1903–04	45,000	.....	17,250
Nov.–Feb.	1928–29	9,700	26.3	1913–14	77,760	210.6	36,920
March–July	1930–31	22,392	8.8	1906–07	685,000	268.0	255,620
Aug.–Sept	1930–31	614	....	1906–07	37,000	.....	7,380
Annual	1930–31	37,000	12.2	1906–07	785,900	258.2	304,370

is due to the porous alluvial character of the soil, the sluggish flow of the stream and the seepage and diversion caused by numerous dams, together with the frequent diversion of water according to needs rather than in proportion to the amount available. With this character of the soil the runoff of one season is influenced materially by that of the previous season. After a dry season the moisture in the soil must be replenished from the new season's supply, thus decreasing the runoff. This replenishment has amounted to as high as 20 per cent of normal, or 61,000 acre-ft. For the present season, owing to the long-continued drought, the probable seepage or replacement loss was estimated at 80,000 acre-ft. This factor does not enter into the forecasting of flow in the other streams covered.

To deliver the largest possible supply of water that the Humboldt drainage area can furnish and to deliver it to those owning prior rights, it will be necessary to clear the channel and to eliminate the oscillation or flash of the stream by distributing the water in accordance with the probable seasonal flow. The latter is now being done. It is considered that with present knowledge and experience of this stream and its peculiar conditions it will be possible automatically to forecast this seasonal flow within satisfactory and useful limits. Until the present season successful forecasts have been made by comparison with previous seasons of similar snow cover, winter weather and runoff. However, this success is said to have been based upon good fortune rather than upon formulas, such as have proved reliable on other streams of different character.

◆

New Welded Truss Design Uses Continuous Tension Members

NEW welded buildings to be erected at the Derry, Pa., and Mansfield, Ohio, plants of the Westinghouse Electric & Manufacturing Co. will incorporate welded roof trusses of a new and unusual type, in which continuous-strap tension members are used, each strap being welded at its ends to the top chord and bent in such a way as to form two diagonals and a portion of the bottom chord of the truss, whose section is increased from the ends toward the center in such amount that the unit stress remains nearly constant throughout. The welding and assembly labor on the truss is said to be less than is required on ordinary welded-truss designs, and in addition there is said to be a considerable saving in weight resulting from designing the truss members to carry a uniform unit stress. Both fillet and butt welds are used.

In effect, the truss is an expansion of the king-post principle. In the 52-ft. truss shown in the accompanying illustration (weight of truss, 2,000 lb.) the top-chord compression member is a 5-in. H-section, and there are three continuous tension straps and twelve short struts. The struts are welded to the top chord at purlin points and converge in pairs at the bottom chord, forming six isosceles triangles. The three tension straps of 4-in. plates furnish the six diagonal tension members and the bottom chord of the truss. These straps, the ends of which are welded to the top chord at corresponding points on opposite ends of the truss, run diagonally downward and inward to the point of convergence of the two immediately adjacent struts and then along the truss to form the bottom chord. By this arrangement the bottom-chord section increases in area from the end toward the center; in the first panel one strap comprises the bottom chord, in the second panel this is augmented by a second strap, and in the center panel all three straps are utilized. The unit stress in the bottom chord and the tension diagonals is nearly uniform, ranging between 12,500 and 13,500 lb. per sq.in. as indicated in Fig. 1.

A pair of these 52-ft.-span trusses was subjected to a full-load test, as shown in Fig. 2. Each truss carried a load of 39,600 lb. Strain-gage readings showed an agreement accurate to 5 per cent between calculated stresses and measured stresses in the members. The truss design was developed by J. E. Webster, general works engineer of the Westinghouse Co. The Derry building will require ten trusses of 52-ft. span and thirty of 30-ft. span.

Fig. 2—Continuous-tension-member trusses under test showed close agreement between measured and calculated stresses.

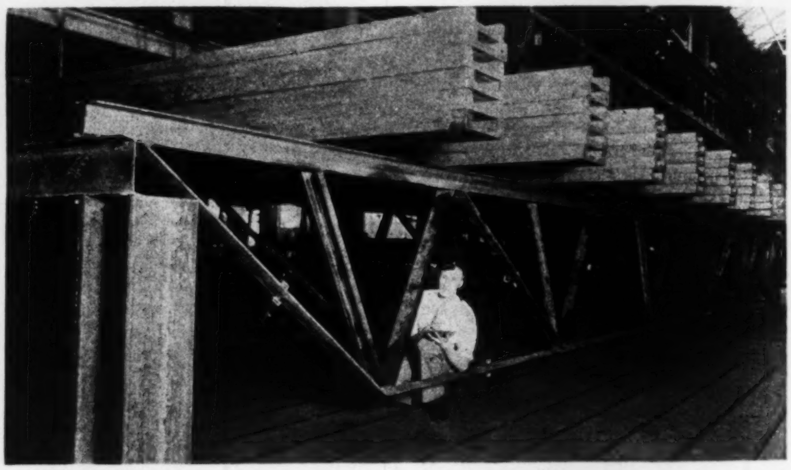
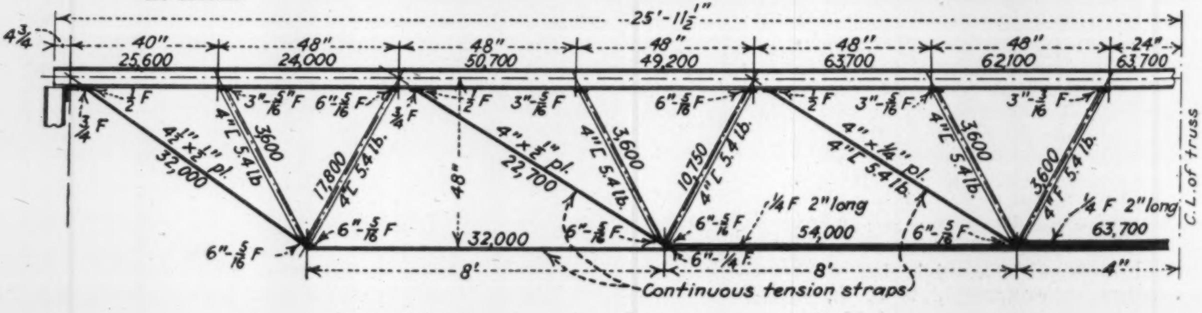


Fig. 1—New type welded truss in which are continuous. Tension-member sections onals and a portion of the bottom chord, are continuous. Tension-member sections are varied so that unit stresses throughout are uniform.



Progress in Filtering the Water Supply of Chicago

Conservation of water must precede filters—Numerous experimental results incorporated in tentative designs—Inshore intakes to replace present cribs —Activated carbon in some form surely to be used

In Supplying Chicago with water the problems of filtration and waste prevention are closely linked, since it is not economically feasible to filter enough water to handle the present 300-gal. per capita rate. Since 1926 experimental work has been carried on, first in a temporary chemical laboratory and since 1928 in one of the most complete and elaborate testing stations any city has yet provided for its water experts. While these experiments have been under way preliminary designs of several filtration plants and studies of sites for these structures have been reviewed by the city engineering department. A summary of 63 major testing-station experiments and a résumé of the engineering studies were presented recently to the Illinois section of the American Water Works Association by Myron B. Reynolds, city engineer, and Arthur E. Gorman, filtration engineer. The following notes are abstracted from this paper. —Editor.

PRELIMINARY studies of filtration for Chicago were based on the construction of four plants to be located along the lakefront near the existing four major lake tunnel systems. Capacities were based on the present policy of not metering small consumers, whose average use is 300 gal. per day. Each structure was planned to project into the lake one-half mile and to be built within a cofferdam. A low-lift station would be located on the lake side. The water would flow landward through mechanical mixing basins, primary and secondary settling basins, filters and clear-water basins, thence through a tunnel connection to the existing high-lift pumping stations.

During the past year several developments have occurred due to findings in the experimental station, the most important of which is that there is no material advantage in obtaining water from the present deep-water cribs, since the higher turbidity in water near shore would assist coagulation. The higher contamination over that obtained from the present intakes is not a serious factor. Present designs, made under the immediate direction of Alfred H. Marshall, designing filtration engineer, are based on taking water directly from the lake end of the filtration plants, thus saving a friction loss amounting to 8 ft. of head and increasing materially the capacity for the distribution of filtered water through existing tunnels, to the pumping stations.

A special short tunnel from the filtered-water storage to the nearest pumping station and a connection from the reservoir to the service tunnel to other stations would form in effect a shunt system similar to the one used in Detroit (*ENR*, Dec. 26, 1929, p. 1,011) and would allow the head on the land tunnel to be maintained constantly at the most economical level. The system on the south side of the city, now having an economic capacity of 500 m.g.d., could be increased to 657 m.g.d.

If the 300-gal.-per-capita consumption of today is to be continued, additional tunnel capacity will be required in 1938. With the per-capita consumption cut to 170 gal., the service capacity under the plan proposed will be ample for 3,900,000 people on the south side alone.

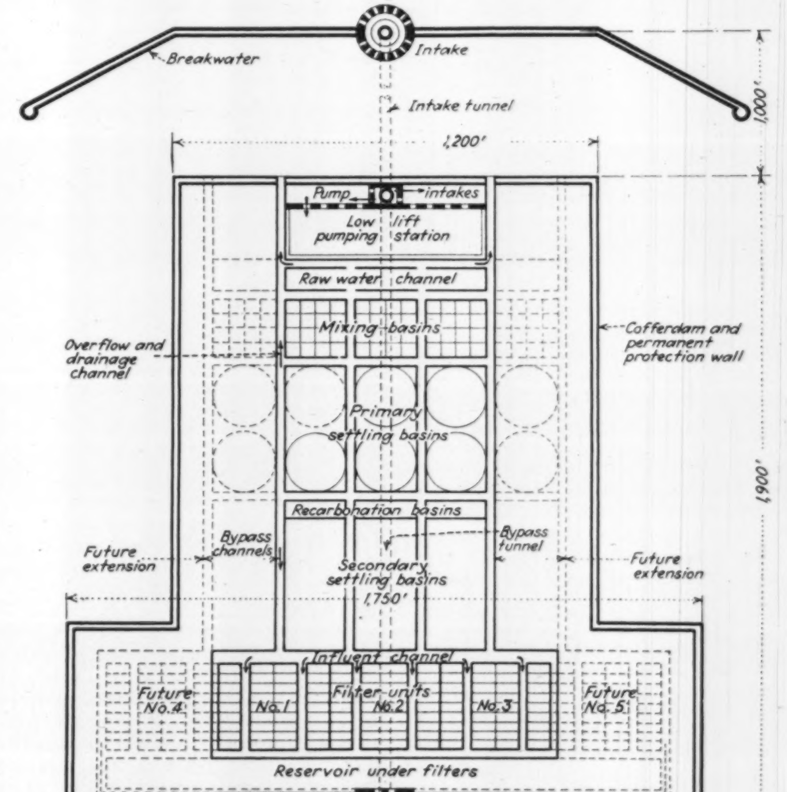
The present situation, then, resolves itself into a choice between providing additional tunnel capacity in the immediate future, or curbing the present wasteful use of water. If the latter alternative is chosen, the saving will be enough to offset the cost of filtration.

The south side is logically the first one to be provided with a filter plant since the existing facilities in that section are so nearly up to capacity and the cribs take water from the most polluted area along the Chicago waterfront.

The location allowing the lowest cost for connections to distribution tunnels is along the lakefront between the Southwest and 68th St. lake tunnels. Negotiations for the acquisition of a site with the South Park and private land owners having riparian rights have already been started.

A tentative layout is shown herewith, providing for an original three-unit plant within a cofferdam extending into the lake. The space between the structures and the cofferdam walls would be filled with material taken from the lake bottom. The space thus provided would give area for two additional units. Consideration of a continuous waterway along the lake shore from the mouth of the Chicago River to Calumet Harbor has necessitated a design limiting the extension of the cofferdam into the lake to 1,500 ft. The original design called for an extension of 2,600 ft. This shortened structure puts the inlet in 18 ft. of water

Fig. 1—Tentative design layout for south side filter plant for Chicago, built on lakefront within cofferdam provided with space for extensions.



instead of 20 to 22 ft. The plant has the axis of the filters lying north and south, at right angles to the settling basins, making a T arrangement of the units. Should the plan for a shore waterway be adopted, the intake would be located on the lake side of the waterway breakwater and connected to the plant by a tunnel under the channel. In this case a secondary inlet from the channel directly into the plant would probably be advisable.

Special studies are being made of revenue and consumption with the purpose of developing a practical program for waste elimination on the south side so that the filtration project may be expedited. It is quite evident that an effective water-conservation program must precede filtration. It is believed, however, that when the facts are made known to the citizens of this section they will gladly exchange the privilege of wasting water for filtration. When filtered water is supplied to the south side it is planned to close the necessary valves in the distribution system, so that the area served with filtered water can be clearly defined and the rates increased in this district to such an amount as is authorized to absorb the cost of purification. It is believed that the deferred expenditures in new plant structures that the south side would need, should the present high rate of consumption continue, would more than offset the cost of the filtration plant and that payment from the general water fund for construction of this filter plant would be an equitable plan. In recent years the major expenditures from the general water fund have been made for central and north district improvements; and if the present rate of consumption is continued, it is the south side that will need the next new tunnel.

A summary of the findings of the 63 major experiments, made under the direction of John R. Baylis, physical chemist, on methods of treating Lake Michigan water follow:

Chemicals—Aluminum sulphate is an efficient coagulant, but the water is so clear at times that a rapidly settling precipitate is not formed, making it necessary to use some other treatment to produce filter runs long enough for the practical operation of a large plant. Lime and ferrous sulphate, though more expensive, produce a rapidly settling precipitate, overcoming the short runs caused by heavy microscopical growths. Lime and chlorinated ferrous sulphate give better results than ferrous sulphate alone. Other treatments such as excess lime, lime and sodium aluminate, sodium aluminate and aluminium sulphate all give good results but are not economical for Chicago water. Fer-alum offers some possibility if it can be sold cheaper than aluminum sulphate.

Mixing—At least one hour's mixing is required to produce fairly large-size particles of flocculated matter during the winter months, but the most economical time, when everything is considered, is 45 to 50 min. Experiments and investigations are still under way to determine the desired mixing time and the proper degree of violence of agitation in the maxing basins.

Settling—When the water contains more than 25 p.p.m. of turbidity, fairly rapid settling of the floc takes place. However, for long periods the turbidity, consisting mostly of algæ, is below 10 p.p.m. As the entrapment of the organisms by the coagulant does not add weight, an artificial heavier turbidity must be added. Lime, to produce partial softening, appears to be a cheap method. A settling time of at least four hours is then desirable.

Basin Type—The type of basin depends on the treatment adopted. In case softening is provided, continuous sludge removal in the first part of the settling is indicated, followed by a longer settling period in plain tanks.

Filters—Units of 4 m.g.d. each are considered most economical. Washing at 20, 24 and 38 in. of vertical rise per minute produced an equally good effluent, but the filter with a 20-in. rise accumulated mud at the surface of the bed. Surface cracks and mud balls appeared in the filter with a 24-in. vertical rise. The filter with a 38-in. rise kept in better condition, but the bed was still not perfect. A surface wash of 4 in., with 20 in. or less wash applied in the usual manner, maintained the filters in much better condition, and this method will probably be incorporated into the Chicago design.

Filtration rates considerably in excess of 125 m.g.d. per acre are feasible during a large part of the year, but owing to the periods of weak flocculation it is considered best to design the plant so that the maximum rate during the peak load of the day will not exceed 156 m.g.d. per acre. Operating results at present show that the maximum demand is 134 per cent of the average. Due to the fact that the periods of weak flocculation occur only in the winter when the peak load demands are less, the designed rate for the first plant may be set at 186 m.g.d., which is suitable for summer conditions. An economic balance must be drawn between filtration rates, consumption load and plant costs before a decision on the rated capacity of the filter units can be made.

Carbon—Taste and odor-removal studies have been given a great deal of attention. Phenol, oil-refinery wastes and algæ are the principal offenders. Whether to use granular carbon in beds or powdered carbon in basins is still undecided, but one or the other will be recommended.

Decisions in Engineering Law

By Herbert Braasch

Attorney at law, New York City

Decisions reached in cases tried in the higher federal courts and in the state supreme courts are summarized in these articles appearing from time to time in *Engineering News-Record.* —Editor.

Liability in Blasting Operations

Explosives were used in blasting by the Sherman Power Construction Co. in development of a hydro-electric project at Bellows Falls, Vt. The principal explosives storehouse was located on the opposite side of the river, but a smaller storage hut was established in the thickly settled part of the town and within 50 rods of five dwellings, a hotel, a factory and business buildings and in immediate proximity to the work. About 1,000 lb. of dynamite being used daily, the hut supply was replenished each day, and the explosive there warmed as required for use.

While workmen were removing the explosive an explosion occurred which could not be attributed to negligence or unskillful handling. Three persons were killed, a number were injured and considerable property was damaged. Mrs. Exner was one of the injured, and her dwelling, distant considerably more than 50 rods from the explosion, was severely damaged, whereupon she brought action against the construction company.

A Vermont statute provided "Keeping Explosives—A person who keeps or suffers to be kept upon premises owned or occupied by him within 50 rods of an inhabited building of another person, more than 50 lb. of gunpowder or nitroglycerine at one time, or more than 1 lb., unless contained in sound canisters of tin or other metal, or a package containing more than 50 lb. of dynamite, shall be fined $25, and $25 additional for each day that it is so kept after notice from an inhabitant of such town to remove the same."

The contractor testified there was no place where the dynamite hut could be located that would be accessible to the work and not be within 50 rods from an inhabited dwelling, and if it had been placed beyond that limit the explosive would necessarily have been too cold for use before it reached the job and would have been carried more frequently through the streets of Bellows Falls to the greater peril of the inhabitants; also that the hut was adopted as a place to store a supply of dynamite for daily use after a hearing before the deputy fire marshal of the state and with his consent.

Mrs. Exner claimed among other things the contractor was liable because more than 50 lb. of explosive had been stored in violation of statute. The court held she was not entitled to recovery on this ground because she inhabited a dwelling more than 50 rods from the dynamite hut. The only purpose of the provision for fines for continued violation was to afford ample means for informing the storer of dynamite of his violation of law.

The court then considered the question whether there is absolute common law liability for damage caused by explosives. Explosives are one of that class of elements which one who stores or uses in such a locality or under such circumstances as to cause likelihood of risk to others stores or uses at his peril. He is an insurer and is absolutely liable if damage results. This liability is not founded on illegal storage or negligence, which is not proved, but upon the ground that the use of dynamite is so dangerous it ought to be at the user's risk. The same rule applies whether injury occurs in storage of explosives or in blasting.—*Exner vs. Sherman Power Construction Co., Circuit Court of Appeals, 2d Circuit.*

* * *

Effect of Extras in Extending Time for Completion

W. C. Christesen contracted for the construction of 2.7 miles of highway, agreeing to complete the work by Aug. 1, 1925. After the award changes were made by which 0.4 mile was added. The project was completed some time after Aug. 1, and the highway commission sought to deduct for delay after allowing some arbitrary time for the added work. The matter of completion time had been neglected and forgotten by the parties in making their revised agreement.

It was held that this substantial addition to the work by change order nullified the provision that the project should be completed Aug. 1, and the contractor in the absence of an agreement by him to complete by a certain date was entitled to a reasonable time in which to complete the entire work and the engineer was not free to fix such limit arbitrarily.—*W. C. Christesen vs. State Highway Commission, Missouri.*

* * *

Worker's Status Determined by Control Over Employment

The Porter Construction Co. was engaged in laying pavement in the city of Tulsa and in carrying on this work cement, sand and gravel were hauled from the contractor's yards and plant to concrete mixers at the job, a distance of several miles. Burton was one of a group of truckmen each of whom furnished his own truck and transported these materials at unit rates per load. While making such delivery Burton met with an accident, and a question arose whether Burton was an employee and entitled to workmen's compensation for the injury on the theory that injury was sustained in the course of his employment; or whether he was, as the Porter company claimed, an independent contractor.

An independent contractor is one who performs services according to his own manner and method free from the employer's control and discretion except as to the result or product of the work. The method of determining payment is not controlling, and piece workers using the employer's equipment are clearly not independent contractors.

At the loading and unloading places contractor's employees directed Burton where to place his truck; loading and unloading were done by construction company employees; payment was at a base rate of 25c. per one mile haul and 15c. per mile thereafter. The company foreman directed Burton where to go for material; whether to load cement, sand or gravel. He was required to work while the mixer was being operated—that is, was directed when to begin and when to stop work. A certain route was designated over which to haul, but this was only for the purpose of determining the distance of haul. Burton used his own truck, kept it in repair and was at liberty to operate it himself or to employ another to do so. It was held there was not such control over Burton as to make him an employee but that he was truly an independent contractor.—*Porter Construction Co. vs. Burton, Oklahoma.*

* * *

Construction Is Not Manufacture

The benefit of certain tax exemptions accorded manufacturers was claimed by the Koss Construction Co., an Iowa corporation. The law defines manufacturers thus: "Any person, firm or corporation that purchases, receives, or holds personal property of any description for the purpose of adding to the value thereof by any process of manufacturing, refining, purifying, combining of different materials or by the packing of meats, with a view to selling the same for gain or profit shall be deemed a manufacturer."

The Koss company stated it was engaged in the business of constructing pavements and selling them; that in its business reinforcing steel, crushed rock or gravel, sand, cement and water are combined in accurately determined proportions, which is done by the use of machinery which is of a portable nature, built for and appropriate to that purpose, and the product (finished pavement) is sold.

The Iowa court, confirming Pennsylvania cases on tax exemption in manufacturing, agreed that "construction" is not "manufacture" within the meaning of these exemptions. Construction, be it of highways or of buildings, is the creation of an improvement to real property. The exemption was meant to apply to improvement of personal property, the product remaining personal property, as distinguished from construction or the attaching of such personal property to realty where it becomes a real property fixture.—*In Re Koss Construction Co., Iowa.*

* * *

Contractor's Execution of Faulty Plans

The MacDougald Construction Co. undertook the paving work, including storm sewers, catchbasins and manholes, of a Milledgeville street in which there had been a surface drain ditch between street and sidewalk discharging into a perpendicular sewer. Plans, specifications and contract for the work, called for 4-ft. raising of the sewer into which surface water had drained, converting the open perpendicular drain sewer into a closed manhole and leaving no opening into which accumulating surface water could drain.

While the project was under way protest was made to the contractor and the city as to the plan. After completion, a hard rain caused the surface water to overflow the sidewalk and flood the storage basement of the Bass Canning Co., resulting in great damage. The property owner brought action against the city, which had prepared the faulty plan, and against the contractor, who had executed the work in strict accordance with plans, specifications and his agreement.

The defense of the city was that construction and maintenance of a sewerage and drainage system is related to the preservation of public health and is therefore governmental. A municipal body is not ordinarily liable for negligence of its agents or servants where the acts complained of are connected with such governmental function; and included in this class are errors of judgment of city engineers or departments of public works in adopting a general plan or drainage and determining when, where and of what size and at what level drains or sewers shall be located.

The court held that there was a modification to this rule to the extent of allowing recovery in cases where negligence or error of judgment by the city results in a permanent nuisance dangerous to life or health and where there is special damage to an individual because of the close proximity of the nuisance to his own property. Such party can recover.

It was held that if the city was liable the contractor necessarily must also be liable, for the adoption of the faulty plan by the board of public works could cause no damage without its execution by the contractor. An injury is not excused because it is done in the execution of a contract. Rather it would furnish the contractor a valid ground for attack and for refusal to perform. The contractor and the city are joint-tort-feasors. The wronged party could recover his damage from either. — *Bass Canning Co. vs. MacDougald Construction Co., Georgia* .

Engineering News-Record

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Sane Views Are Returning

RISING prices of important construction materials indicate that industrial views are again becoming sane. For many months manufacturers and contractors have been strangely eager to produce at red-ink figures; as prices went lower they bid more and more aggressively. This tendency in part reflected an expectation that the decline would continue, but in part is was blind, ruthless competition in the hopeless attempt to fill up plant capacity by cutting prices. Everybody lost in the process, seller, buyer and public alike, the greatest loss to the public being in value deflation. The present upward trend, manifested most definitely in the cement price increases in the Mid-West and East, suggests that the downward course of sentiment is ended and that thoughts are again centered on profit, solvency and business stability—objectives of utmost importance.

Signs of New Activity

DISTINCT signs of a revival in engineering construction since late spring are so markedly unseasonal as to hold out encouraging prospects of progressive recovery. Off to a poor start at the first of the year and falling to the lowest monthly volume in a decade in March, construction activity as represented by contract awards has failed to follow the usual early summer slump, but instead has shown a steady increase, culminating in July awards reaching the highest weekly average of any month this year. Valuable furtherance of this growth of construction activity may be expected from the work of the National Committee on Trade Recovery and the American Society of Civil Engineers to promote early utilization of Relief Act construction loans. Further welcome help might be extended by technical societies, industrial associations and companies connected with the construction industries, for every individual interest is bound up in general recovery. The current signs of resumed construction lend vigor to such efforts.

No Parking Re-Indorsed

AFTER some years of success with a no-parking ordinance covering the downtown streets, Chicago has just reaffirmed faith in the ordinance after considering its repeal. The merchants had protested that streets were discouragingly empty; and though they could not prove that lines of parked automobiles along the curbs would bring them more customers the city fathers gave favorable hearing to the protest. But in the final vote the decision was to retain the parking prohibition. Whoever has observed the condition of the Loop streets since the ordinance was passed and compared it with the previous condition will agree with those who voted to retain the law in effect. The problem of dealing with automobile traffic in business streets is not solved by a no-parking rule, and much work remains to be done before the final solution is reached. Yet there is enough experience to show that restrictions on parking in business streets are essential, even to the extent of forbidding parking.

Revise Your Road Estimates

REGULATIONS issued by the Bureau of Public Roads governing the use of hand labor on road work performed with money provided by the Emergency Relief and Construction Act require careful study by contractors who are looking forward to employment on such work. As summarized in this issue, the list of operations that must be performed by manual labor appears formidable. Subjected to analysis, however, the abandonment of machine methods called for is not remarkably extensive. Many of the operations are normally hand operations or else are performed by hand as often

Put It to Work!

WHEN Congress passed the Relief Act and provided one and a half billion dollars for constructing self-liquidating local public works, it did so not to aid the construction industry nor to serve the mere convenience of the local communities but to create employment and restore normal business life. It sought to assure the physical and mental well-being of millions of families whose livelihood has disappeared. A partnership of the national government with states, cities and other public agencies was set up for the public welfare. It remains to make this partnership effective.

The construction fund is a relief fund of tremendous potentiality. Its utilization, and above all its early and complete utilization, is the responsibility of the officials and engineers of the local governments. Every day that the great fund remains idle serves to continue hard times. The growing roll of the unemployed—Cleveland's jobless increased from 138,000 to 168,000 from February to June of this year—sounds a warning of the conditions against which the country is battling.

What the local authorities do or fail to do concerns us all. Our recovery depends on rapid and effective transmutation of the money into employment for millions of idle men, and each city and state bears its share of the responsibility. Each construction project begun, whether in Pittsburgh, in Kansas City or in Houston, contributes to the welfare of every other community in the country.

Problems of the utmost difficulty are involved in changing from a basis of taxation to one of tolls, as required by the act. However difficult, they must be met promptly. It is the duty of local government officials and engineers to plan their works, apply for funds and start construction, to end unemployment.

as by machine. Obviously there will follow some reduction in the use of equipment and some increase in the cost of construction, even allowing for the fact that reduced wage scales bring hand labor into far closer competition with mechanical equipment than hitherto. State highway departments and contractors working under the new provisions should not overlook the fact that the restrictions they put on freedom of construction methods, however justified these may be for the relief of unemployment, warrant new scrutiny of cost and performance estimates.

An Idea Crystallized

GROUPS of exhibition halls are rising along the offshore park area out from Chicago's southerly lakefront, where the Century of Progress exposition is to open next June. In spite of the short ten months the exposition probably will open on time; the physical plant, at least, promises to be ready. Contained in these buildings there are to be exhibits portraying significant steps in the material development of industry and noteworthy accomplishments of scientific endeavor. A wide range of the country's productive activities will be covered, though doubtless not all. This conception of what a modern exhibition should place before the eyes of its visitors—essentially an adaptation on large scale of the plan of technological and industrial museums—seemed an unpromising idea when first proposed, but it evidently has crystallized into practical reality. The full success of the plan will increase the esteem in which technologic knowledge is held by the general public, and this effect should be valuable to engineers. And what is no less important, its inspirational effect in suggesting new ideas to the more receptive visitors may bring future developments of value.

Levees Alone Again Fail

THE high water of the Yangtse River, which in 1931 inundated the great alluvial valley of China, ranks as probably the most disastrous flood of reliable record. The account of the lands and communities flooded and of the population driven from its homes by the rising waters is given in this issue. Compared with the Mississippi flood of 1927 and the previous greatest Yangtse inundation of 1870, the Chinese flood of a year ago was cataclysmic. The waters rose 3 ft. higher than ever before, and levees that had been built higher and stronger through generations, as successive high waters had established new possible flood crests, were surmounted and breached. Nature again set at naught, as it has done repeatedly, man's assumptions of highest possible floods and dependence on a restrained river for protection. The solution of the Yangtse flood problem remains to be worked out, but it is definitely evident from the experience of 1931 that other means than levees alone must be employed. The article in this issue points to a combination of channel regulation, diversion channels and reservoirs as the logical line of attack on the great flood-protection problem that confronts the Chinese people. In proposing only part defense by levees the plan closely follows recent flood-control thinking wherever alluvial rivers are having to be brought under control. In every part of the world floods present problems so great that all the devices available to the engineer must be called upon.

New Equipment Horizons

THE German-built Vermunt dam described in this issue is a notable illustration of the trend toward plant automaticity shown in recent large-volume concreting operations. Among current American undertakings, the plants for preparing concrete aggregate and for batching and mixing concrete at the Hoover Dam naturally assume prominence as examples of this high degree of mechanization. But the train of equipment for the Vermunt dam surpasses even those installations.

It was virtually a dam-building machine. There was no break in the production flow from the raw-material bins to concrete in the forms. The significant construction lesson is that this continuous thin stream speedily built up concrete yardages commonly considered possible only with equipment capable of handling large containers. Except for logical gravity drops and the one brief vertical lift at the distributing towers, belt conveyors performed all movement of materials.

It is probable that the continuously moving train of more than two miles of belt conveyors at Vermunt dam has never been equaled on a construction operation. But quite beyond any question of records is one fact of outstanding importance: the fact that transportation of concrete by belt succeeded in highly satisfactory manner in handling a no-slump mix. In this respect above all, the concreting plant at the Vermunt dam advances current practice in concrete construction and throws new light on the possibility of aiding quality by skillful adaptation of equipment.

The Power Act Is Upheld

SEVERAL of the elements entering into the cost of waterpower plants built under federal license were the subject of a significant ruling by the Federal Power Commission last week. Two of the commission's findings are of special importance. One relates to the cost of lands and power rights, the other to legality of fees paid to a construction subsidiary.

The plant under consideration is Mitchell Dam of the Alabama Power Company, the first plant to be the subject of a finding by the commission as to what construction costs may be charged to the capital account of a plant built under the federal waterpower act. The commission cut a claim of $3,500,000 for "lands, water rights and franchises" to $76,135, eliminating all increments brought about but juggling the stock of subsidiary companies; only the actual cash expenditures of subsidiary companies in making the original purchases were allowed. The commission threw out entirely a fee of $183,540 paid to the Dixie Construction Co., a wholly owned subsidiary, this with the caustic statement that the fee was included with a "view of obtaining emoluments and profits not otherwise allowable under the law."

The decision is convincingly written and is a clear indication that the reconstituted power commission is determined to maintain the spirit of the federal power act. The sooner public utilities wake up to this fact and conform to the spirit of the law the better chance there will be for the continuation of utility operation in their hands. The weakness of the case presented by the power company in this instance cannot but tend to shake confidence in the financial practices of utility companies, a confidence already much disturbed.

NEWS OF THE WEEK

Public Agencies Prepare Applications for Federal Funds

PUBLIC agencies, cities, counties and states, in widely scattered sections of the country, are preparing to present their applications to the Reconstruction Finance Corporation for loans under the authorization of the emergency relief bill for public-works construction and direct unemployment relief.

The city and county agencies of Los Angeles, Calif., formally moved on July 25 to obtain from the R.F.C. $42,000,000 for the building of transmission lines from the Boulder Canyon project and for county flood control projects. Of this, $32,000,000 was requested by the board of water and power commissioners for the construction of the proposed transmission lines and for betterments and extensions of the municipal power and light system. The formal resolution voted by the board supplements an oral request made earlier in July by the bureau's representative in Washington. The county board of supervisors directed the county counsel to proceed with the legal formalities looking toward application for a loan of $10,000,000 to be used in furthering the county's flood control project. It also requested that the corporation allot money to California, particularly to Los Angeles County, for unemployment relief. An announcement has also been made by the city of Long Beach, Calif., that it will join with the city of Los Angeles in a request to the corporation for $1,500,000 for breakwater construction.

Projects at New Orleans

Plans are being advanced for the borrowing of funds from the R.F.C. for the construction of the New Orleans Public Belt bridge across the Mississippi River. The bridge was to have been financed by the sale of $7,000,000 in bonds of the Louisiana highway commission and an equal amount from the New Orleans Public Belt R.R., the latter amount to be retired from earnings. The highway department funds are to be advanced for the inclusion of a toll-free motor vehicle crossing.

Also at New Orleans, the Orleans levee board has filed an application with the

(Continued on p. 144)

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Bids Asked on New York's First Relief Bill Project

The first of the federal aid projects made possible by that portion of the federal relief bill fund assigned to New York got under way on July 29 when bids were advertised for a $1,500,000 contract to pave Grand Central Parkway in the borough of Queens, New York City, and Northern State Parkway, its extension in Nassau County. Work is scheduled to begin in four weeks and to be completed by the end of the year. A thirty-hour work week will be required, which, it is estimated, will give employment to about 3,000 men on a two-shift basis.

The $1,500,000 to be used for paving the two parkways will come from the $6,200,000 which is New York State's share of the $120,000,000 provided in the relief bill for federal-aid highway work.

◆

Sewer Service Charges Proposed in New York City

The New York Department of Sanitation has proposed to the city government that it be allowed to levy charges for sewer service as a revenue-raising measure. If such a plan is adopted, it is estimated, the revenue produced would be between $8,000,000 and $10,000,000 yearly. It has also been proposed that further revenue-raising measures be adopted, including a tax of $25 upon each truck unloading at municipal docks, a similar tax for hog farmers who cart garbage out of the city, and charging for the privilege of placing advertisements on refuse cans.

New York State is one of the twenty states in which legislation has been provided enabling cities to levy sewer service charges. The New York law limits the use to which such charges can be put to the payment of the cost of management, maintenance, operation and repair of the sewerage system and treatment works.

City Forces to Complete the Hetch Hetchy Project

The low bid of the city to finish the Hetch Hetchy water supply development has been accepted by the San Francisco Public Utilities Commission after several weeks of study. Contract was awarded on the bid of $5,257,665 by the city construction force to finish the Coast Range tunnel driving and lining. The next lowest bid of a private contractor was $5,815,335. Date for completion of the contract is set for February, 1934, and the utility commission estimates that water will be delivered in the city four months later.

The call for bids resulted from the provision of the new San Francisco charter requiring the taking of open bids on all municipal work. The remaining work on Hetch Hetchy consists of 6.3 miles of tunnel driving and 16 miles of lining. To date all work on the Coast Range tunnel has been carried on by force account and the acceptance of the city bid will mean continuance of the work under the same organization. About 900 men are now employed on the work. The figure of the low city bid includes a 10 per cent item for contingencies but does not include a performance bond, which was the point attacked by the private bidder.

Work will go forward under the direction of M. M. O'Shaughnessy, chief consulting engineer for the commission, and Lloyd T. McAfee, chief engineer in charge of Hetch Hetchy construction.

Hand Labor Specified for Many Operations Under Emergency Road-Construction Program

To give wider direct distribution of money provided for highway construction by the emergency relief and construction act, hand labor is to be required where it can be employed without great sacrifice of efficiency

REGULATIONS issued by the Secretary of Agriculture and instructions sent out by the chief of the Bureau of Public Roads relating to federal-aid funds, provided by the emergency relief and construction act contain new requirements for the use of hand labor in road construction. Operations that are to be conducted by hand labor are ordinary clearing and grubbing; trimming of slopes in cuts and fills; spreading of fills; trimming of ditches; certain types of grading; ditching; backfilling; unloading pipe, tile, cement, reinforcing steel and aggregates; carpenter work; subgrading for curbs and gutters; digging post holes; painting; spreading stone and gravel; spreading covercoats; sweeping; certain loading operations. The specific items are as follows:

Grading operations

All incidental or ordinary clearing and grubbing shall be done by hand labor or teams or both. The use of explosives will be permitted for loosening stumps.

All trimming of slopes in cuts and fills and spreading of fills, when the material contains little or no rock, shall be done by hand labor.

Turnpike sections may be constructed by means of power-hauled graders but ditches, other than in turnpike sections, shall be trimmed by hand, or by the use of board scrapers. The finishing of earth road surfaces may be done by power operated graders.

All subgrading or fine grading between forms; fine grading of foundations to place and setting forms for paving; the fine grading of the subgrade to prepare it for the pavement, when no forms are used, and the finishing or trimming of slopes, shoulders and ditches after the pavement is completed shall be done by hand.

Trenches for pipe, tile drains and similar structures shall be dug by hand or team labor. The use of explosives will be permitted where necessary. Pipe shall be unloaded and placed by hand. The use of cranes, block and tackle, and any other equipment operated by hand or team power, will be permitted. Backfilling of excavated material shall be done by hand or team labor and hand mixing of concrete for head walls and pipe encasement will be required.

Culverts and small bridges

All excavation and back filling shall be done by hand tools such as picks, shovels and wheelbarrows, or by team tools, such as scrapers and carts. The use of explosives will be permitted, also power operated pumps where necessary. Where the excavated material is required to be lifted more than 6 ft., hoists, operated by animal or manual power will be permitted.

Cement and reinforcing steel shall be unloaded by hand, may be hauled by trucks, but shall be placed by hand. Aggregates shall be unloaded from cars by hand and shall be handled from the stocks piles at the structure to the mixer by hand shovels, wheelbarrows, or carts, or other hand or team-labor methods. All carpenter and form work shall be by hand. The use of steel forms, where allowed by the specifications, will be permitted. Concrete shall be transported from the mixer to its place of use by carts or wheelbarrows. Chutes, where allowed in the specifications, will be permitted. Finishing of structural concrete surfaces shall be done by hand rubbing, or other hand methods.

Subgrading for curbs and gutters shall be done by hand labor or by teams or both. Concrete and its constituent materials shall be handled as specified under culverts and small bridges.

All post holes shall be dug by hand. Special hand tools will be permitted. Posts, where available in the quantity and quality required, shall be cut in the vicinity of the proposed work. All painting shall be done by hand.

Surface courses

Initial spreading of the slag, stone or gravel and all filler (dust, screenings, chips, sand, etc.) shall be spread by hand labor. Filler shall be broomed into the surface by hand brooms.

Spreading of covercoats by hand will be required. All handling of stone, slag or gravel from railroad cars to the hauling equipment shall be done without the use of power equipment. Sweeping of the roadway, where required, shall be done by hand brooms or by team-operated equipment.

Sweeping and cleaning of base course in preparation to receive the surface course, where necessary, and initial spreading of coarse stone shall be done by hand. Chips shall be spread and may be broomed by hand.

Premixed bituminous mixtures and natural asphalts which are delivered cold shall be unloaded from railroad cars by hand. The finishing and smoothing of surface may be done by machine.

Concrete pavements

The use of concrete mixers in tandem will not be permitted. Curing shall be done by the earth covering method, except where the adjacent soil contains so much rock as to render it impracticable to obtain sufficient suitable covering material from the shoulders. Covering material shall be spread and removed by hand.

In the roadside production of crushed stone and gravel the stone shall be loaded in the quarry by hand. Where the crusher is set at approximately the same elevation as the floor of the quarry, the stone shall be transported to the crusher by hand or team methods. Where feasible, team power or hand labor will be used in gravel pits for transporting material to screening plants or loading traps. Stripping of quarries and gravel pits, where feasible, shall be done by team or hand labor methods or both.

In large bridge work all painting of steel work shall be done by hand. Cleaning may be done by sand-blast. The use of steel forms will be permitted. As far as practicable, all other work shall be done by hand labor methods.

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Army Engineer to Head R.F.C. Advisory Board

President Hoover has announced that an "engineer of standing" will be delegated by the Army Engineer Corps as chairman of the board of outstanding engineers to advise the Reconstruction Finance Corp. in regard to self-liquidating projects for which loan applications are made.

The President also stated that stimulation of a movement for slum clearance and replacement is being given immediate examination with a view to early expansion of employment through such programs of modernization.

$4,000,000 Asked of R.F.C. to Build Dotsero Cut-off

A loan of $4,000,000 from the Reconstruction Finance Corporation to build the Dotsero cut-off has been applied for by the Denver & Rio Grande Western. The road also has asked the I. C. C. for an extension until July 1, 1934 in which to buy from minority stockholders 20,530 shares of Denver & Salt Lake stock at the stipulated price of $155 a share. The purchase had previously been ordered by the Interstate Commerce Commission.

◆

S.P.R. Seeks to Postpone Building Station in Houston

Because of its decreasing revenues and the uncertainty of any immediate improvement in business conditions, the city commission of Houston, Tex., has been requested by President A. D. McDonald, of the Southern Pacific Railroad to grant that railroad permission to postpone construction of its proposed $7,000,000 passenger station. No action has yet been taken on the request. The Southern Pacific has already spent $1,039,000 in preliminary work on the project and the city has spent approximately $2,000,000 as its share in changing the course of Buffalo Bayou, street extensions and underpasses.

◆

Illinois Road Contract Annulled Because of Labor Trouble

Because of threatening labor conditions, on recommendation of the attorney general, the Illinois highway department has annulled the contract for the construction of a $202,000 road project in Bond County, Ill. The contract had been awarded on June 28 to the Dungey & Cochran Construction Co., of Marion, Ill. Officers of the construction company requested that the contract be invalidated. Strong protests have been made against the rates of pay prevailing on the job, and a group of 300 men recently interfered with the unloading of the contractor's equipment. It is reported that the contractor has carried out other state projects at a wage rate of 30c. an hour.

NEW HENLEY BRIDGE AT KNOXVILLE, TENNESSEE

The Henley Bridge recently placed in service in Knoxville, Tenn., after a construction period of about fifteen months, is a notable project inasmuch as it provides a much needed traffic outlet to the south for Henley Street, an important business artery in the city, the widening of which was described in *Engineering News-Record*, April 17, 1930. The total improvement, including the bridge and street widening, cost about $1,900,000. According to Hal H. Hale, office engineer, city engineer's office, Knoxville, no unusual processes were involved in the design or construction of the bridge. A 54-ft. roadway and two 6-ft. sidewalks are provided. The channel is 317 ft. A cavernous underlying rock structure required that a considerable amount of water be handled in constructing the foundations. All piers are founded on solid rock.

The Tennessee highway department is now beginning construction of a new 100-ft. highway connecting with the southern terminus of the Henley Bridge and extending into the Great Smoky Mountain National Park now under development by the U. S. Park Service. This will provide a direct route into the park from the north. Some of the road work in the Great Smoky Mountain National Park was described in an article in *Engineering News-Record*, July 14, 1932.

The Henley Bridge was designed by the Marsh Engineering Co., Des Moines, Iowa. Supervision, under separate contract, was by L. M. Dow, Knoxville, Tenn. General contractors for the work were Booth and Flinn Co., Pittsburgh, Pa.

Bonnet Carrè Spillway Crossing Award Sustained by Court

An award of $741,093, granted by the special spillway appraisal commission to the Louisiana highway commission for the construction of a highway crossing over the Bonnet Carrè spillway has been sustained in the federal district court in New Orleans. The Louisiana highway commission had sought a larger award and the federal government a lower one. If the award is not contested further by the federal government, the project will probably be carried into construction at an early date in order to take advantage of low costs and to give employment. The new causeway will be about 8,000 ft. long, as the width of the spillway at the weir is 7,698 ft. and the guide levees flare out as they approach Lake Ponchartrain.

◆

Louisiana Governor Vetoes Bills Concerning Public Works

Among the bills passed by the recent Louisiana state legislature and vetoed by the governor were two regulating the contract construction of public works. The bill requiring that public contracts amounting to more than $50,000 should be awarded to citizens of Louisiana or firms owned by citizens of Louisiana was vetoed because it was held to be unconstitutional. The veto was also applied to the bill that would have required public boards to issue to contractors certificates showing that money was on hand to cover the full amount of the contract. The reason for this veto was not stated. Under such a law the bonds to finance a project would have to be sold in amounts large enough to cover the various contracts before the contracts could be let.

◆

New Value Recommended for Important Railway Properties

New figures for the value of the St. Louis & O'Fallon R.R. for the year 1920 and for subsequent years have been set by an examiner for the Interstate Commerce Commission. The values proposed, if approved by the commission, would be substituted for those rejected by the United States Supreme Court in 1929.

The St. Louis & O'Fallon R.R., a small line having no national significance as a transportation unit, sprang into prominence by being chosen by the railroads for the purpose of testing valuation findings of the Interstate Commerce Commission in the courts. The value subsequently fixed on this railroad by the commission was rejected on the ground that the "cost of reproduction new" had not been considered in fixing the valuation, as required by the federal statute. The court did not state what weight should be given to the cost of reproduction new (*ENR*, May 30, 1929, p. 869).

Subsequently the Interstate Commerce Commission reopened the St. Louis & OFallon valuation case and a new value as of 1920 has now been set. It is $344,000 higher than the earlier figure. The examiner is believed to have arrived at this higher figure by adding together $563,000 (the original cost of the road and equipment brought up to 1920) to $1,216,000 for cost of reproduction in 1920 at "period prices," dividing by two and adding $48,000 for land and $77,000 for working capital. The prices used were an average of prices over a period of years. Such period prices were taken by the examiner as a more logical basis than the spot prices urged by the representatives of the railroad. Spot prices in 1920 were at an abnormally high peak.

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Power Plant Cost Cut by Federal Power Commission

FIGURES for the "actual legitimate original cost" of the Mitchell Dam of the Alabama Power Co., a hydro-electric power development built under license from the Federal Power Commission were drastically cut in a finding given out by the Federal Power Commission on July 29. The Alabama Power Co. claimed $10,646,056 as the actual cost of the project up to and including Dec. 31, 1925; the commission has allowed $6,173,576 plus an item of interest during construction which is being calculated on the basis of rates and methods agreed upon between the commission and the power company.

The principal item eliminated was $3,423,864 from the power company's figure of $3,500,000 for the actual cost of land and power rights to the licensee. The second major item was entire elimination of $183,540, the fee of the Dixie Construction Co., the construction subsidiary of the power company which built the power plant.

The Mitchell Dam project was built under a license granted June 27, 1921, for the construction of a power plant at Duncan's Riffle on Coosa River in Alabama. In the determination of the actual cost of the project, as required by law, the major items of cost involved in the actual construction were accepted by the commission's accounting division. The principal items referred to the commission itself for a final ruling were the cost of land, power rights and franchises, general administration expenses of the Alabama Power Co., the fee of the Dixie Construction Co., the charge from the power company for power used during construction at commercial rates and interest charges during construction.

The commission refused to accept the power company's claim that the costs of land, water rights and franchises were properly represented by the par value of stock issued in the consolidation of five pre-existing companies through which the Alabama Power Co. obtained control of the major land and rights needed for the power development. As the consolidated companies all were under the control of one company, thus making the transfer of control largely a bookkeeping operation, the commission only allowed the actual cost to the original companies of the land and power rights, a total amount, as closely as it could determine, of $76,135.

The charge of $171,028 as representing the actual cost of service of general officers and employees devoted to the Mitchell Dam project was allowed by the commission.

A fee of $183,540 representing a 3 per cent profit computed upon the direct and overhead costs of the Dixie Construction Co. on the Mitchell power project was thrown out entirely with the statement that the company was "in substance a department of the licensee's own business, maintained during construction of this and other of its public utility projects with a view to obtaining emoluments and profits not otherwise allowable under the law."

The charge for electric energy was reduced from the commercial value to actual cost.

Fuller extracts from the commission's findings will be given in a subsequent issue.

◆

Applications to Be Made For R.F.C. Funds

(Continued from p. 142)

R.F.C. for a loan of $4,000,000 to be used for the completion of Shushan airport, including hangars and other required structures, and for the completion of the Lake Ponchartrain reclamation program. The reclamation program is financed by bonds to be retired from proceeds from the sale of the high class real estate sections created.

Mayor John F. Dore of Seattle has stated that his city will probably ask from the R.F.C. a loan of $6,000,000 to $8,000,000, the money to be expended on public improvements. This amount is exclusive of the funds that the superintendent of lighting hopes to obtain for the completion of the Skagit power project.

Ohio water conservation

It is proposed to seek the aid of the R.F.C. to bring about the immediate development of the water conservation program in Geauga County, Ohio. The plan involves the valley of the Cuyahoga River. A dam is to be built at Hiram Rapids in Portage County which will create a reservoir 15 miles long, covering 10,000 acres. The project is the site of Akron's projected water supply and the city has already invested one million dollars in the preliminary work. It is estimated that the project will involve the expenditure of $6,000,000.

The city law department of Cleveland, Ohio, has begun a detailed study of the relief act to determine what opportunities it may afford the city for obtaining federal funds from the R.F.C. The chairman of the city council committee on elimination of slums and blighted areas has announced that he will ask the city engineer to make a survey of the city to find out if there are any self-liquidating projects for which federal aid might be obtained. He stated that if it were possible to sell bonds for the waterworks expansion project to the R.F.C., an acceleration of the $58,000,000 expansion program might take place. The administration also might reopen a study of the advisability of expanding the municipal light plant with R.F.C. funds. He further gave his opinion that consideration should also be given to the possibility of making the city's sewage disposal system self-liquidating.

Sewer system for Atlanta

Atlanta, Ga., has requested a loan of $10,000,000 for the modernization of its sewer system. The city council has passed a resolution requesting the loan and authorizing the mayor to take whatever steps are necessary to come within the requirements laid down by the administrators of the relief law.

It has been decided to revive temporarily the Alabama Emergency Employment Commission, under authority of the Alabama Industrial Board, to survey the state and prepare and present to the R.F.C. any construction projects which could be brought under provisions of the relief bill. The efforts of the commission will be directed only to the section of the bill dealing with self-liquidating projects and not to the direct relief nor the highway-construction features. The State Industrial Board, which is the executive committee of the employment commission, will act as a clearing house to give legal, engineering and financial advice to any project that might fall within the scope of the bill. Its services will be offered to cities and counties of Alabama, as well as to any group that might have a construction project that would be considered by the R.F.C.

The state highway commission of South Carolina has applied for a loan of $10,000,000 under Section 1 of the relief act, the section providing for loans for direct relief, intending to use the entire amount for highway construction. Such construction could be started immediately and could be continued in full force throughout the coming winter. The highway commission and the state administration believe that the use of federal funds in this manner is far more desirable and effective than as direct relief. They think that direct relief cannot be administered properly and would establish an undesirable precedent, whereas highway building would afford relief to a large number of citizens and represent a profitable investment for the state.

◆

Hoover Dam Notes

Two-thirds of the concrete has been poured for the lining of the diversion tunnels at Hoover Dam. At the close of the week ending July 23, practically 10,000 ft. of tunnel lining had been put in place. The total length of the four tunnels is 15,900 ft.

* * *

During the week mentioned excavation was begun on the slots for the bulkhead at the inlet portal of tunnel No. 1 and for the stoney gate at the outlet portal of tunnel No. 3. Work was continued in the open cuts on the Arizona and Nevada spillways. Blasting operations proceeded at the Arizona intake towers. The work of enlarging the Nevada inclined spillway tunnel was resumed. Drilling of low-pressure grout holes in tunnel No. 4 was started July 17.

* * *

A total of 1,341 cars of concrete aggregate was shipped during the week from the Arizona deposit. At the mixing plant 16,775 cu.yd. of concrete were manufactured.

* * *

According to Babcock & Wilcox Co., contractor on the penstock pipes, the main pipe plates will be rolled at Gary, Ind., and curved and fabricated at the plant to be built near the dam site. Some of the lighter steel will be rolled at the Pueblo plant of the Colorado Fuel & Iron Co. A 100-man dormitory and 25 homes will be started at once at Boulder City for the housing of Babcock & Wilcox employees.

$1,400,000,000 of Public Works Wait Better Financing

A list of public works that have been held up for lack of funds, prepared by the American Society of Civil Engineers as part of its activities in developing a normal program of public-works construction, has been given out by the society as an aid to those seeking self-liquidating projects which may be carried out with money made available under the emergency relief act. As the list was prepared before the relief bill was passed in its final form many projects are listed which are not now self-liquidating, as required by the act. Some of these however, can be made self-liquidating by appropriate legislation.

A summary of the list of projects given out by the society follows:

Alabama	**$2,950,000**
Bridges and tunnels	$1,000,000
Sewerage	1,950,000
Arizona	**$25,060,000**
Sewerage	$1,254,000
Irrigation and flood control	23,516,000
Arkansas	**$1,995,000**
Bridges	$1,000,000
California	**$397,515,000**
Bridges	$110,000,000
Sewerage	2,300,000
Waterworks	263,488,000
Flood protection	18,537,000
Power development	3,000,000
Included herein is: Golden gate bridge, $35,000,000; San Francisco Bay bridge, $75,000,000; Los Angeles aqueduct, $220,000,000.	
Colorado	**$9,003,000**
Waterworks	$5,623,000
Flood protection	3,350,000
Connecticut	**$1,690,000**
Sewerage	$1,190,000
Waterworks	500,000
Florida	**$51,500,000**
Bridges	$1,500,000
Canal (Cross-State)	50,000,000
Georgia	**$14,912,000**
Bridges	$450,000
Sewerage	14,277,000
Included herein: Atlanta sewerage system, $14,000,000.	
Idaho	**$1,000,000**
Waterworks	$1,000,000
Illinois	**$74,719,000**
Bridges	$6,200,000
Sewerage	62,525,000
Waterworks	5,620,000
Included herein: Chicago sewage disposal, $50,000,000.	
Indiana	**$4,100,000**
Waterworks	$4,100,000
Iowa	**$1,250,000**
Railroads (Sioux City Station)	$1,025,000
Kentucky	**$1,190,000**
Waterworks	$1,190,000
Louisiana	**$28,695,000**
Bridges	$27,600,000
Included herein: Public Belt bridge, $14,500,000.	
Maine	**$2,000,000**
Bridges	$2,000,000
Maryland	**$30,000,000**
Bridges	$13,550,000
Waterworks	1,250,000
Ports	3,000,000
Railroads	10,000,000
Airports	1,650,000
Included herein: Chesapeake Bay bridge, $10,000,000; Pennsylvania R.R., $10,000,000.	
Massachusetts	**$31,100,000**
Bridges and tunnels	$5,350,000
Sewerage	7,100,000
Waterworks	17,000,000
Flood protection	1,000,000
Michigan	**$34,000,000**
Bridges	$12,000,000
Sewerage	3,000,000
Flood protection	10,000,000
Miscellaneous municipal	8,000,000
Minnesota	**$18,800,000**
Bridges	$1,500,000
Sewerage	15,000,000
Waterworks	2,300,000
Included herein: Minneapolis sewerage system, $15,000,000.	
Missouri	**$2,622,000**
Bridges	$2,000,000
New Jersey	**$33,018,000**
Sewerage	$18,018,000
Waterworks	15,000,000
New Mexico	**$6,430,000**
Flood protection	$6,200,000
New York	**$478,410,000**
Bridges and tunnels	$155,962,000
Sewerage	37,442,000
Waterworks	174,546,000
Slum eradication	10,350,000
Ports	40,000,000
Flood protection	6,875,000
Miscellaneous municipal	56,235,000
Airports	7,000,000
Included herein: Vehicle tunnel, 38th St., $80,000,000; Tri-borough bridge, $30,000,000; New York sewage disposal, $30,000,000; Delaware water supply, $59,000,000; Brooklyn water tunnel, $64,000,000; New York City water main enlargements, $32,000,000; Rochester water supply, $12,000,000; Christie-Forsyth St. housing, $10,000,000; New York municipal docks, $40,000,000; New York garbage disposal, $12,600,000; Brooklyn Marine Park, $15,000,000; Long Island Parkway, $11,146,000.	
North Carolina	**$4,371,000**
Sewerage	$3,801,000
Ohio	**$16,607,000**
Sewerage	$11,357,000
Waterworks	4,000,000
Miscellaneous municipal	1,250,000
Included herein: Cleveland sewage disposal, $11,000,000.	
Oklahoma	**$3,395,000**
Sewerage	$2,025,000
Waterworks	1,170,000
Oregon	**$12,115,000**
Bridges and tunnels	$2,500,000
Miscellaneous municipal	9,500,000
Pennsylvania	**$29,804,000**
Bridges and tunnels	$5,804,000
Sewerage	14,000,000
Miscellaneous municipal	10,000,000
Included herein: Philadelphia subway, $10,000,000.	
Rhode Island	**$2,050,000**
Sewerage	$1,050,000
Tennessee	**$1,170,000**
Bridges	$1,100,000
Texas	**$36,502,000**
Sewerage	$9,785,000
Waterworks	2,200,000
Ports	5,400,000
Flood protection	18,807,000
Virginia	**$11,803,000**
Bridges and tunnels	$11,000,000
Waterworks (Richmond)	803,000
Included herein: Norfolk-Portsmouth vehicle tunnel, $10,000,000.	
Washington	**$20,139,000**
Bridges	$1,900,000
Sewerage (Seattle)	2,050,000
Waterworks	1,452,000
Ports	12,000,000
Miscellaneous municipal	2,737,000
Wisconsin	**$2,500,000**
Bridge (Superior)	$1,500,000
Waterworks	1,000,000
Porto Rico	**$7,750,000**
Waterworks (San Juan)	$1,500,000
Irrigation	5,000,000
Grand Total	**$1,402,600,000**

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New C.P.R. Tunnel Put in Service at Vancouver

The new Canadian Pacific Railway tunnel at Vancouver, B. C., connecting the False Creek yards with tracks on Burrard Inlet water front, was put into operation on July 17. The new tunnel, which was started early in 1931, eliminates a number of grade-crossings in the downtown section of the city and will speed up traffic in that area. The tunnel, lined with concrete throughout, is 4,600 ft. long, 29 ft. high and 23 ft. wide. It is single-tracked. The construction work was carried out by the Northern Construction Co., Ltd., and J. W. Stewart, Vancouver, and the cost of the project was about of $1,750,000. The cost was borne jointly by the Canadian Pacific Railroad and the city of Vancouver, with contributions from the dominion government grade-crossing fund and the British Columbia Electric Railway Co.

Obituary

Henry Hampton Kerr, vice-president of United Engineers & Constructors, died in Chicago, Ill., on July 21. Mr. Kerr was associated with Westinghouse, Church, Kerr & Co. from 1886 to 1920 and was vice-president when that firm was taken over in 1920 by the Dwight P. Robinson Co., Inc.

Joseph F. Ranger, president of Casper Ranger Construction Co., Boston, Mass., died on July 21, age 60.

Elgin E. Mott, president of the American Blue Print Co., New York City, died of heart disease at White Plains, N. Y., on July 20, age 69.

Antonio Guell, consulting sugar engineer and former professor of engineering at the Louisiana State University, died July 20, from what was believed to be a self-inflicted pistol wound. He was a native of Costa Rica, coming to the United States when 16. He was with the Louisiana State University during the World War.

Frank Kaufman, who has been engaged in levee contracting for some years, died in Vicksburg, Miss., early this month, at the age of 45. He was formerly with E. W. Roach, levee contractor, and with the Morrissey-Easton Contracting Co.

Laurence Clark, until recently an officer of the Frontier Construction Co., Buffalo, N. Y., died July 16 in Fort Erie, Ontario, at the age of 74.

John B. Myers, president and founder of the Myers Construction Co., died at his home in Clayton, Mo., on June 30, at the age of 66. Mr. Myers organized the Myers Construction Co. forty years ago. A notice of his death was incorrectly reported in *ENR*, July 14, 1932, p. 62, as that of Charles B. Myers. This notice is published as a correction of the earlier item.

Sir William Willcocks, the projector and designer of the Aswan Dam, died in Cairo, Egypt, on July 28 after a few days illness. He was active in his youth in India, in his middle years in Egypt and South Africa and during his later life served in Mesopotamia. He was credited with being one of the world's authorities on irrigation, and at the invitation of the Secretary of the Interior visited the United States in 1914 to give advice on the regulation of the Mississippi.

Morris Bien, former assistant United States Reclamation Commissioner, died at his home in Takoma Park, Md., at the age of 74. A lawyer as well as a civil engineer, Mr. Bien, through a large part of his long career in government service, was able to combine his knowledge of both professions. From 1893 to 1902 he was connected with the General Land Office in Washington. For the succeeding 22 years he was in the Reclamation Service, now the Bureau of Reclamation, as assistant commissioner in charge of lands and contracts, and at times acting as director and commissioner of the department.

C. U. Boley, until his retirement last year city engineer of Sheboygan, Wis., died July 20. He was 77 years of age and was graduated from the University of Wisconsin in 1883. His early work was in mining and school teaching. In 1888 he became city engineer and retained that position for 43 years. During that time the population of the city increased from 10,000 to 40,000. He laid out the first sewer system and recently started a survey for revamping the old one.

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Engineering Contracts and Capital

Heavy engineering construction contracts reported for the past week total $28,166,000, maintaining the high level for the year set in July. Federal government awards accounted for $6,742,000 of the past week's contracts. Private work amounted to $3,480,000, while state and municipal contracts totaled $17,944,000. Large contracts let during the week include: Hetch Hetchy water tunnel, awarded to the city construction department of San Francisco, $5,258,000; Mississippi river levee work, aggregating $1,500,000; grain elevator, Chicago, $1,000,000; eighteen-story state capitol, Bismarck, N. D., $2,000,000; and state highway contracts over $1,500,000 in Nebraska, Texas and New York.

Cumulative contracts from the first of the year to date total $733,955,000, as compared with a total of $1,676,483,000 for a similar period last year.

New capital issues for the past week amounted to $6,800,000, all of which were public, led by West Virginia's road bond issue of $2,000,000.

CONSTRUCTION
(Thousands of Dollars)

	Weekly Average Aug., 1931	Weekly Average July, 1932	Week Aug. 4, 1932
Federal government...	$2,710	$11,176	$6,742
State and municipal...	17,904	11,962	17,944
Total public........	$20,614	$23,138	$24,686
Total private.......	16,612	6,989	3,480
Week's total........	$37,226	$30,127	$28,166

Cumulative, Jan. 1 to date:

1931 construction..................	$1,676,483
1932 construction..................	$733,955

Decrease, 55 per cent.

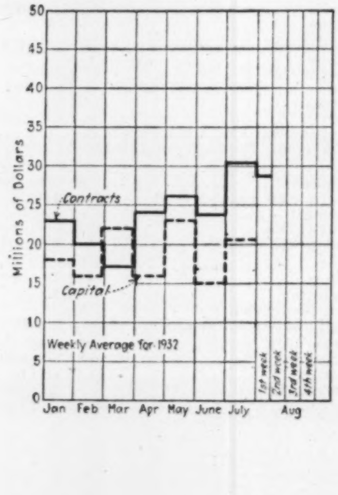
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

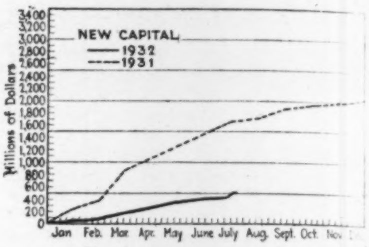
	Weekly Average July, 1931	Weekly Average July, 1932	Week July 30, 1932
Total private and public	$41,500	$20,500	$6,800

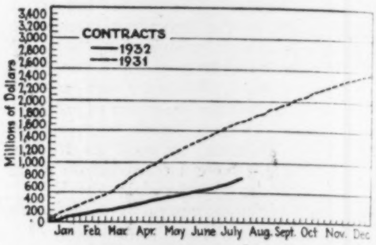
Cumulative, Jan. 1 to date:

1931 new capital..................	$1,631,000
1932 new capital..................	517 000

Decrease, 68 per cent.







ENR Cost and Volume Index

Cost		Volume	
August, 1932...	**156.80**	**July, 1932........**	166
July, 1932......	153.36	June, 1932........	131
August, 1931....	171.38	July, 1931........	248
1931 (Average)..	181.35	1931 (Average)....	220
1930 (Average)..	202.85	1930 (Average)....	260
1913 Average.......	100.00		

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SOCIETY CALENDAR

AMERICAN ASSOCIATION OF ENGINEERS, annual convention, Washington, D. C., Sept. 26-28.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, Washington, D. C., Nov. 14-18.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, White Sulphur Springs, W. Va., Oct. 11-14. (tentative).

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, Washington, D. C., Oct. 24-27.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, annual meeting, Toronto, Ont., Canada, Oct. 18-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Atlantic City, N. J., Oct. 5-8.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, New Orleans, La., Nov. 14-18.

AMERICAN WELDING SOCIETY, fall meeting, Oct. 3-7, Buffalo, N. Y.

ASPHALT INSTITUTE, Asphalt Paving Conference, New Orleans, La., Dec. 5-9. The ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS will meet in conjunction with the paving conference.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, annual conference, Pittsburgh, Pa., Sept. 29-Oct. 1.

INTERNATIONAL CITY MANAGERS ASSOCIATION and GOVERNMENTAL RESEARCH ASSOCIATION will hold a joint annual conference at Cincinnati, Ohio, Oct. 24-26.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS, annual meeting, Hot Springs, Ark., Nov. 15-18.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, New York City. Sept. 29-Oct. 1.

NATIONAL SAFETY COUNCIL, annual congress, Washington, D. C., Oct. 3-7.

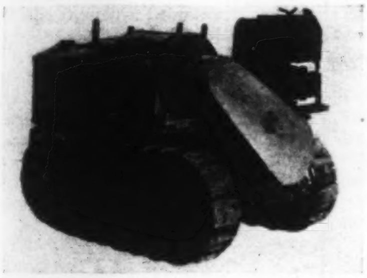
NEW ENGLAND WATER WORKS ASSOCIATION, annual meeting, Springfield, Mass., Sept. 27-30.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION, annual meeting, Chicago, Ill., Sept. 20-22.

Construction Equipment and Materials

Tractor-Mounted Welder

A new welding machine that can be mounted on the framework of any standard-make tractor is announced by Schramm, Inc., of West Chester, Pa. The welder is operated by a V-belt drive from the rear power take-off. It is located beside the driver's seat on a removable sliding frame. The control panel is on the side opposite the welding unit. The unit is of the single-arc, variable-voltage type. Sizes, for mounting on tractors of sufficient power rating, include 200, 300, 400 and 600 amp. The machine is especially adapted to the welding of pipe lines, railroad work, bridge construction, building construction, tank erection and miscellaneous repair work. The maker states that the welder mounting does not affect the pulling or towing feature of the tractor drawbar.



Electric welder mounted on tractor.

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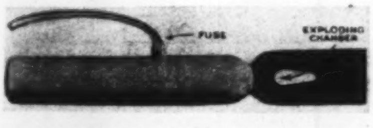
Timber Split by Exploding Wedge

An exploding wedge, for use in splitting timber, is being introduced by the Hutchison Manufacturing Co., 7721 Susquehanna St., Pittsburgh, Pa. A small steel cylinder attached to the steel wedge, is to be filled with blasting powder and fitted with a fuse. After a paper wad has been inserted, the wedge is driven into the timber and the fuse lighted. The wedge can be used a number of times.



Exploding wedge for splitting logs.

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Survey of Culvert Conditions Reported in "Truth Book"

Something new in manufacturers' catalogs has been introduced by the Armco Culvert Manufacturers' Association, Middletown, Ohio. The new publication is entitled "The Truth Book" and reports the result of a country-wide survey of the present conditions of a large number of culverts of different types and built of different materials. The survey covered more than 2,000 drainage structures in 26 states. The ages of the culverts examined were from ten to twenty years. Each culvert on the route selected was carefully examined, and a photograph was taken. The results of the examination and the photographs were then mounted in a larg folio to form "The Truth Book."

In addition, the book shows the results of comparative durability studies on some 12,734 culverts of all types, from four to twenty years old. Seventy-six per cent of these culverts were inspected by state highway engineers. These surveys were more detailed than the local trips, and the results were obtained by mathematical ratings.

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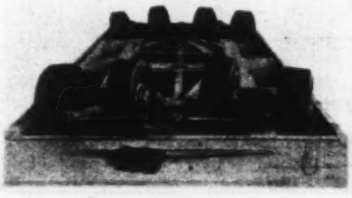
Heavy-Duty Trailer

The LaCrosse Tu-Way, new type of heavy-duty carry-all trailer, has been announced by the C. R. Jahn Co., 1140 First National Bank Building, Chicago, Ill. The trailer is fully reversible and may be pulled, steered and braked from either end. It is built in capacities of from 10 to 40 tons. Its construction eliminates the necessity of a high front deck. Its low platform may be loaded from either end or side. There are eight wheels, mounted in pairs. The beams making up the mainframe members are tapered, permitting axles to be mounted beneath the beam ends. This method of mounting makes possible free tilting and pivoting action of wheels and axles. The trailer has a short turning radius. Eight-wheel steering and eight-wheel braking is secured, regardless of the position of the pivoting axles.



La Crosse Tu-Way trailer, turned over.

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Business Notes

The Coast Engineering & Equipment Co. has been organized by Dan R. Brown and J. Royden Estey to engage in engineering and the engineering sales of heavy-duty construction and building equipment. The company's offices are at 420 East 8th St., Los Angeles, Calif. The company proposes to represent five to seven manufacturers of construction equipment and to have an equal number of engineering accounts. The services provided by the company are sales, construction engineering, mining and industrial engineering, and financing.

Pettibone Mulliken Co., Chicago, Ill., announces that the Moon Track Co., Chicago, has been merged with it to form an industrial equipment division. R. W. Moon, vice-president and sales manager of the Moon Track Co., will be sales manager of the new division. The address of the new division will be Pettibone Mulliken Co., 4710 W. Division St., Chicago, Ill.

New Equipment in Brief

Flexible-Rigid Steel Rule—Two new steel rules of the pull-push type, to retail at a low price, are announced by the Stanley Rule & Level Plant, New Britain, Conn. The rules have a 6-ft. steel blade that is both flexible and rigid, coiled in a watch-size steel case. One rule has a $\frac{1}{2}$-in.-wide blade and is supplied with a chromium plated case. The other rule has a $\frac{3}{8}$-in. blade and a nickel-plated case.

Bulk Cement Weigh Batcher—An automatic weighing batcher for bulk cement has been introduced by the Fuller Co., Catasauqua, Pa. The machine is built to the 1932 New York state highway specifications. The design is based upon a flood-proof measuring feeder of high accuracy. The important feature is the Fuller rotary valve used as the discharge gate of the batcher. This gate offers a large free outlet for the discharged cement, operates freely and does not leak. A double seal makes it possible to control the discharge and prevent loss by splashing.

Highway Crossing—The Truscon Steel Co., Youngstown, Ohio, has put on the market a new type of grade-crossing pavement that combines steel and concrete construction. The new pavement, known as the Truscon Steel Concrete Crossing, consists of pressed-steel channel sections, or planks, the full height of the rail, which are filled with concrete and laid in position on the ties between and outside the track rails. The channel sections are 6 ft. long and 16$\frac{3}{4}$ in. wide and are pressed from $\frac{3}{16}$-in. steel plates. The sections are filled with concrete by the user. The sides of all sections are tapered inward, forming a key for the incased concrete. The end sections have one end terminating in a ramp to prevent its catching dragging equipment on trains.

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New Publications

Buckets—A six-page folder descriptive of the new Williams "Champion" series of Favorite and Hercules buckets has just been issued by the Wellman Engineering Co., Cleveland, Ohio. The folder describes the company's new bucket, which is characterized by high digging capacity, faster and cleaner dumping and rugged construction.

Road Adjuster—The Gledhill Road Machinery Co., Galion, Ohio, in an eight-page booklet entitled "The Gledhill Road Adjuster" describes the company's recent development in making equipment for road leveling. The adjuster is an attachment for graders to replace the moldboard, and it is also supplied as a complete unit with its own chassis. Its chief use is in the finishing of various types of macadam roads to a perfect level or to any desired crown. The bulletin is available for distribution.

Shovels and Cranes—A 40-page illustrated booklet has been published by the Byers Machine Co., Ravenna, Ohio, describing that company's excavating and material-handling equipment, from $\frac{3}{4}$-cu.yd. to 1$\frac{1}{4}$-cu.yd. capacity. By illustration and text the various parts of the Byers shovel are explained, and the many uses to which the machine can be put are described. Seven pages of tabular material are included, giving the clearance dimensions and capacities of the various shovel models.

Business Side of Construction

July Construction Volume Greatest Since November, 1931

ENGINEERING CONSTRUCTION contracts reported for the month of July (four weeks) total $120,458,000, an average per week slightly in excess of 30 millions. This is the highest weekly average reported for any month since last November, when the weekly awards averaged 35 millions. March was the low month in construction for the year, contracts averaging 17 millions. Since that month the construction volume has been steadily increasing, excepting a small drop in June. The *Engineering News-Record* volume index for July is 166, as compared with 131 for June and 149 for May.

Of the July contract totals, $92,502,000 represents public works awards and $27,965,000 private engineering construction. Nearly half of the public works, or $44,704,000, was for federal government work. Highway and street contracts let during the month amounted to $31,469,000. Public buildings awards totaled nearly as much, $27,429,000, with the next highest classification being irrigation and waterways, which, stimulated by heavy work on the Mississippi River, amounted to $23,053,000.

Cumulative contracts reported from the first of the year to date total $715,789,000. Last year the total for the first seven months was $1,729,522,000. Although the volume of work done this year is off nearly 60 per cent from that of 1931, the 1932 monthly contract curve is steadily rising. In a normal year the construction curve rises to a high in the spring, drops through the late spring and summer, rises again in early fall and tapers off towards the end of the year. Last year the curve followed the general trend with the decrease slopes being greatly accentuated over those of normal years. This year, however, the spring and summer slump has not matured, and except for the small June drop, the curve has maintained a definite upward swing since the March low.

Cost index rises

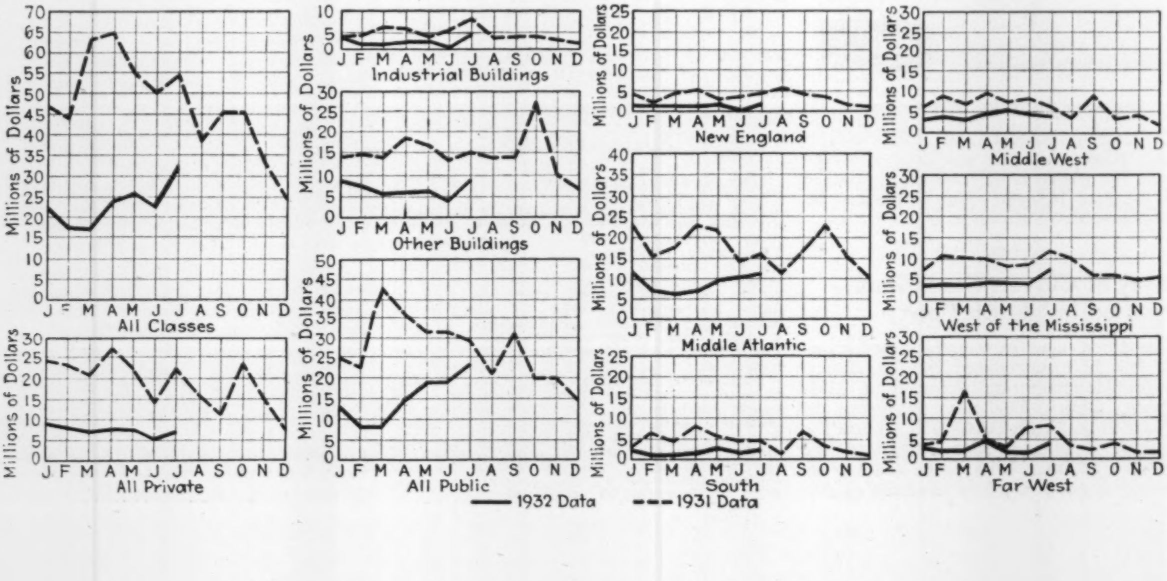
The *Engineering News-Record* cost index, based on the cost of common labor and three basic construction materials, steel, cement and lumber, rose to 156.80

Geographical distribution of heavy engineering construction contracts reported during July, in thousands of dollars. For the first time federal contracts are included in regular classifications, thought federal figures are given as a matter of record. Below are shown average weekly contract awards, in millions of dollars, for various classifications of work and for different sections of the country.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN JULY, 1932

Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States			Canada July, 1932
							July, 1932	Seven Months		
								1931	1932	
Waterworks	57	162	775	535	63	114	1,706	40,421	14,314	1,122
Sewers	139	259	8	282	146	302	1,136	41,670	15,050	105
Bridges, public	861	833	39	1,098	1,599	557	4,987	81,382	30,987	....
Excavation and waterways	....	245	4,315	559	6,839	11,095	23,053	107,813	51,556	55
Streets and roads	1,022	7,963	2,258	10,182	7,186	2,858	31,469	404,064	188,495	2,375
Unclassified, public	181	2,085	88	71	166	131	2,722	57,422	31,852	329
Buildings, public	663	11,756	406	933	12,224	1,447	27,427	209,337	149,218	850
Total public	2,923	23,303	7,889	13,660	28,223	16,504	92,502	941,729	481,472	4,836
Federal government (included in above classifications)	240	10,879	4,764	820	15,334	12,667	44,704	170,819	149,395	....
Buildings, industrial	169	16,824	251	840	230	145	18,459	107,955	63,777	299
Buildings, commercial	2,053	3,125	....	950	470	....	6,598	368,961	123,727	....
Bridges, private	....	500	40	....	....	....	540	8,828	2,624	....
Excavation, private	....	25	....	....	....	....	25	....	525	41
Unclassified, private	140	452	490	1,112	140	....	2,334	211,584	43,664	582
Total private	2,362	20,926	781	2,902	840	145	27,956	697,328	234,317	922
July, 1932	**5,285**	**44,229**	**8,670**	**16,562**	**29,063**	**16,649**	**120,458**	....	....	**5,758**
June, 1932	5,121	49,175	9,221	22,776	20,615	7,826	114,714	....	....	1,104
July, 1931	20,200	82,724	25,277	41,827	34,315	40,767	....	....	....	6,005
Seven months, 1932	48,035	265,339	49,824	129,911	134,515	88,165	....	....	715,789	31,849
Seven months, 1931	114,707	609,383	171,087	259,373	261,708	222,999	....	1,639,257	....	64,676



for August, after falling to 152.20 in June, the lowest since December, 1916. A slight increase in the price of steel brought the index up a little in July, and a strong boost in cement prices was responsible for the August rise. The cost index now approaches the March, 1932 figure of 157.24.

Cement prices increase

The steady downward trend in the prices of construction materials was sharply checked during the closing days of July by a widespread increase in cement prices. Basic mill prices, excluding cost of sacks, were increased 15c. to $1.25 per bbl. at the Cape Girardeau, La Salle, Buffington, Hannibal and Limedale plants, all located in the Mid-west. At Steelton, Minn., a 16-cent increase raises the price to $1.45. Increases of 25c. were noted at Iola, Kan., and Mason City, Ia., plants, making the basic price at these mills $1.35. These Mid-west advances, following early summer rises in several Eastern districts, indicates the cement industry is pulling away from the ruinous low prices established late last year and early this year.

Lumber Market Poor—Production in the lumber industry continues at 22 per cent of normal and 37 per cent of the past three-year average, both in weekly production and that for the year's total. Through efforts of the National Lumber Manufacturers Ass'n, a rigid curtailment of cutting has kept production below shipments and orders for some time. This relation was disturbed during the week ending July 23, when orders dropped 3 per cent below production, a condition appearing to be seasonal in character.

Steel Outlook Brighter—Although production of steel ingots has remained steady at 16 per cent of capacity the last three weeks, considerable optimism prevails in the steel industry in the belief that the low point of production has been passed and that an upturn in steel will commence early in September, if not before. Several mills in the Pittsburgh and Youngstown districts report increased activity with resulting increase in employment. Because of unusually low stocks being carried in the steel centers, even a slight betterment in general business conditions will result in considerable activity in the steel industry.

Little change in wage rates

The month of July was marked by few changes in construction wages. The average common labor rates reported by twenty cities showed a slight rise for the month, now standing at 42.2c. per hour. Employment in most centers remained at the same ratio reported a month ago. It is expected that much employment will result from the operations of the federal relief bill. Hand labor will be required on certain work under some sections of the act. An abstract of rulings made by Thomas H. Macdonald, chief, U. S. Bureau of Public Roads, regarding the requirements concerning hand labor on work coming under the federal emergency highway program is given in the news pages of this issue.

Labor reports from various centers follow:

New York—Members of the Structural Steel Board of Trade, contractors doing much of the steel erection in New York City, although working open shop voluntarily increased the rate of structural steel workers from $12 to $13.20 per day to meet the rate adopted by the unions at the end of the recent building trades strike in the city.

New Orleans—Union carpenters take a voluntary reduction of 15c. per hour, bringing the old 90-cent rate, in effect since 1922, down to 75c.

New Jersey—The Associated Contractors of New Jersey ordered a reduction in the wages of union ironworkers and hoisting engineers from $16 to $14 per day, effective Aug. 1. Labor leaders announced the reductions would be opposed on the grounds that similar reductions in other trades have not increased the volume of construction or relieved unemployment.

Buffalo, N. Y.—Bricklayers, masons and marble setters have taken upon themselves the adoption of a 2½-day week to provide a greater distribution of work.

West Frankfort, Ill.—Union carpenters reduce their scale from $8 to $6 per day.

Ohio—The Ohio state conference of the Bricklayers, Masons & Plasterers International Union have gone on record as favoring a 6-hour day and 5-day week and opposing all attempts at wage reductions.

Salt Lake City—The Orndorff Construction Co. is charged by the Salt Lake Building Trades Council with underpaying workmen and violation of specifications on the new postoffice project, according to a report from that city.

Colorado—Charles D. Vail, recently appointed state highway engineer, has stated the minimum wage on state highway projects will be raised from 50c. to 65c. per hour, with the workmen to be limited to 30 hours per week.

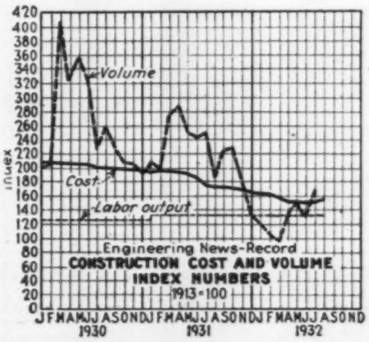
Dallas—Members of the local chapter of the Associated General Contractors have signed an agreement among themselves and have notified the local unions that they will pay 50c. as top wages for skilled labor, excepting bricklayers, who are to receive 62½c. Common labor rates have been set at 25c. and 35c.

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Pile Drivers	Structural Iron Workers	Masons' Laborers	Common Laborers
Atlanta.....	$0.75@1.12½	$0.40@.90	$0.60@1.25	....	$0.60@1.25	$0.25	$0.20@.25
Baltimore...	.90@1.00	.80@.90	1.00@1.37½	$0.65	1.00@1.25	.40	.30
Birmingham	.75@.87½	.60	.75	....	.75	.25@.35	.15@.30
Boston.....	.90@1.30	.80@1.17½	1.00@1.37½	.75@1.07½	1.00@1.37½	.45@.70	.40@.70
Cincinnati..	.90@1.27½	.50@1.02½	1.07½	1.07½	1.06¼@1.20	.70	.40@.45
Chicago....	1.37½	1.31¼	1.31¼	1.31¼	1.35	.82½	.50@.82
Cleveland...	.90@1.37½	.87½@1.12½	.90@1.12½	1.00	.90@1.06¼	.56¼	.30@.72
Dallas......	.62½	.50	.50	.50	.50	.25	.25@.35
Denver.....	1.00@1.12½	.75@.87½	.75@.87½	....	.75@.87½	.50	.31¼@.50
Detroit.....	1.25@1.50	.80	1.25	1.25	1.25	.70	.30@.50
Kansas City	1.30	1.12½	1.12½	1.06	1.12½	.82½	.45@.50
Los Angeles.	.50	.40	.62½	.62½	.62½	.40	.35@.50
Minneapolis	1.10	.75	.80	....	.90	.70	.45
New Orleans	.60@.80	.40@.50	.80@1.12½	.90	.80@1.12½	.50	.15@.20
New York..	1.50@1.65	1.25@1.40	1.50@1.65	1.50	1.65	.81¼@1.00	.50@.75
Philadelphia	1.00@1.25	.60@.90	1.00	.75	1.00	.30@.40	.20@.30
Pittsburgh..	.60@1.50	.60@1.25	.60@1.37½	1.00@1.18¾	.60@1.37½	.50	.40
St. Louis...	1.50	1.25	1.35@1.47	1.25	1.47	1.00	.35@.78¾
San Francisco	1.10	.90	.90	1.00	1.00	.62½	.50@.62½
Seattle.....	.75@1.20	.50@.90	1.00	.90	1.10	.66	.40@.50
Montreal...	.75	.60	.55	....	.70	.45	.25@.30

Construction Cost and Volume Index Numbers

The August Cost Index (156.80) is 2.3 per cent higher than that for July, the increase being due to a rise in cement prices and a slight stiffening in common labor rates. The July Volume Index (166) is the highest since last November, showing an increase of 25.8 per cent over the June volume.



E.N.-R. Cost		**E.N.-R. Volume**	
August, 1932.....	**156.80**	**July, 1932**......	**166**
July, 1932........	153.36	June, 1932......	131
August, 1931......	171.38	July, 1932......	248
1931 (Average)....	181.35	1931 (Average)..	220
1930 (Average)....	202.85	1930 (Average)..	260
1913 average......	100.00		
1931		1931	
January..........	194.48	January........	208
February.........	196.61	February.......	198
March............	194.51	March..........	278
April............	191.63	April..........	289
May..............	189.33	May............	251
June.............	187.23	June...........	243
July.............	174.37	July...........	248
August...........	171.38	August.........	187
September........	171.40	September......	225
October..........	169.78	October........	229
November.........	169.28	November.......	180
December.........	166.23	December.......	133
1932		1932	
January..........	162.48	January........	121
February.........	161.82	February.......	105
March............	157.24	March..........	97
April............	153.12	April..........	135
May..............	152.78	May............	149
June.............	152.20	June...........	131
July.............	153.36	July...........	166
August...........	156.80		

Current Prices of Construction Materials

Building Materials

PORTLAND CEMENT — Prices are for carload lots. For cement in returnable cloth bags add 40c. per bbl.; in non-returnable paper bags add 15c. per bbl., to following net prices:

	F.o.b.	Delivered		F.o.b.	Delivered
Atlanta	$2.10	$2.70	Kansas City	$1.50	$1.60
Baltimore	....	1.77	Los Angeles	2.10	2.10
Birmingham	1.83	1.93	Minneapolis	2.10	2.25
Boston	1.58	1.68	Montreal	1.70	....
Chicago	1.60	1.95	New Orleans	1.86	2.20
Cincinnati	1.52	1.64	New York	1.59	1.70
Cleveland	1.25	1.50	Philadelphia	1.53	1.63
Dallas	2.23	2.38	Pittsburgh	1.68	1.78
Denver	....	2.40	St. Louis	1.64	2.15
Detroit	1.47	1.80	San Francisco	2.45	....
			Seattle	2.55	2.70

Current mill-prices per barrel to dealers, for carloads of 132 barrels or over, without including charge for four bags, f.o.b. Bag charges same as in preceding table:

Alpena, Mich	$1.20	Mason City, Ia	$1.35
Buffington, Ind	1.25	Norfolk, Va	1.61
Dallas, Tex	1.75	Northampton, Pa	1.21
Hannibal, Mo	1.25	North Birmingham, Ala	1.31
Hudson, N. Y	1.21	Richard City, Tenn	1.31
Independence, Kan	1.35	Steelton, Minn	1.45
Ironton, Ohio	1.06	Universal, Pa	1.21
Iola, Kan	1.35	Waco, Tex	1.75
La Salle, Ill	1.25	Wyandotte, Mich	1.20
Limedale, Ind	1.25		

SAND AND GRAVEL — Per ton, carload lots, gravel, size ¾-in.:

	Gravel		Sand	
	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$1.95	$2.75	$1.50	$2.50
Baltimore	....	2.55	....	2.08
Birmingham, per cu.yd	....	3.00	....	2.40
Boston	1.50	1.75	1.00	1.25
Chicago, per cu.yd	....	2.25	....	2.25
Cincinnati	1.30	1.60	1.05	1.35
Cleveland	....	2.00	....	2.00
Dallas, per cu.yd	1.00	1.50	1.00	1.50
Denver, per cu.yd	1.75	1.85	1.15	1.20
Detroit	.50	1.45	.72	1.50
Kansas City	.75	....	.60	....
Los Angeles	1.35	1.45	.85	1.00
Minneapolis	....	1.60	....	.65
Montreal	1.50	....	1.25	....
New Orleans	1.50	2.50*	1.20	2.00*
New York, per cu.yd	1.60	3.25	1.00	2.00
Philadelphia	....	1.66	....	1.38
Pittsburgh	....	1.20	....	1.40
St. Louis	1.00	1.40	.80	1.35
San Francisco	1.75	....	1.75	....
Seattle, per cu.yd	1.75	....	1.75	....

*Cu.yd.

CRUSHED STONE — Per ton, size 1½-in., carload lots, limestone:

	F.o.b.	Delivered
Atlanta	$1.95	$2.75
Baltimore	....	2.60
Birmingham	.80	1.05
Boston	1.50	1.75
Chicago, per cu.yd, 2,500 lb	....	2.25
Cincinnati	1.65	1.85
Cleveland	....	2.00
Dallas, per cu.yd., 2,500 lb	1.90	....
Denver, granite, per cu.yd., 2,700 lb	....	2.50
Detroit	1.09	1.95
Kansas City	1.25	....
Los Angeles	1.35	1.45
Minneapolis	....	1.60
Montreal	1.35	....
New York, per cu.yd., 2,800@3,000 lb	1.60	3.25
Philadelphia	....	2.00
Pittsburgh	....	3.50
St. Louis	1.35	1.65
San Francisco, trap rock	1.65	....
Seattle, per cu.yd., 3,000 lb	1.10	....

CRUSHED SLAG—Prices for carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Slag Sand
Birmingham	$0.90	$1.15	$2.05	$0.55
Buffalo	1.35	1.35	2.25	1.25
Cleveland	1.70	1.70	....	1.35
Toledo	1.20	1.20	1.20	1.10
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown	1.10	1.20	2.00	.75

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Birmingham (5x8x12)	$0.084	Kansas City	$0.16
Boston	.16	Los Angeles	.15
Brooklyn and Queens	.12	Minneapolis	.09
Chicago	.175	New Orleans	.18
Cleveland	.165	Philadelphia	.15
Denver	.15	Pittsburgh	.14
Detroit	.08	St. Louis	.14

READY MIXED CONCRETE—Per cu.yd., 1:2:4, delivered 50 cu.yd. or more:

Atlanta	$7.75	Los Angeles	$5.40
Birmingham	4.90	Minneapolis	5.50
Boston	7.50	New Orleans	6.20
Cincinnati	7.10	New York (Manhattan)	8.50
Dallas	6.00	Philadelphia	5.60
Detroit	5.90	Pittsburgh	5.75
Kansas City	7.50	St.Louis	7.00
		Seattle	5.35

HOLLOW TILE—Building tile per block, delivered to contractors in lots of 2.000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.09	$0.11	$0.13	$0.20	$0.25
Baltimore	.10*	.14	.20	.22*	.30
Birmingham	.089	.122	.167	.219	.25
Boston	.075	.11	.135	.195	.30
Chicago	.0484	.063	.09	.1179	.13
Cincinnati	.05135	......	....	.1232	....
Cleveland	.048	.066	.09	.117	.13
Dallas	.084	.121	.159	.177	.234
Denver	.085	.135	.175	.19	.25
Detroit	.0505	.065	.0947	.1175	.1305
Kansas City	.0755	.092	.15	.17775	.20725
Los Angeles	.09425	.134	.188	.2325	.3115
Minneapolis	.0635	.09395	.1232	.13425	.2103
New Orleans	.085	.115	.16	.225	.255
New York	.075	.1164	.145	....	....
Perth Amboy	.....	....	....	.2388*	.2956*
Philadelphia	.065	.093	.14	.175	.195
Pittsburgh	.0435	.065	.088	.1165	.126
St. Louis	.067	.098	.12	.16	.20
San Francisco	.0765	.105	.1765	....	....
Seattle	.085	.115	.18	....	....

*At plant. (Load-bearing tile).

BRICK — Prices per thousand in carload lots, as follows:

	Common Backing		Face		Paving F.o.b.
	F.o.b.	Delivered	F.o.b.	Delivered	3x8½x4-in.
Atlanta	$8.50	$14.00	$15.50	.....	$32.00
Baltimore	.....	12.00	.....	$25@35	43.00†
Birmingham	10.00	12.50	20.50	23.00	27.00
Boston	11.00	12.50	25.00	26.50	43.00
Chicago	.....	9.00	....	32.50	32.00
Cincinnati	13.50	16.00	.....	24.00	36.50
Cleveland	12.00	14.00	.....	24.00	33.00
Dallas	.....	12.00	.....	23.00	25.00
Denver	13.00	.....	18@27	.....	40.00
Detroit	11.50	12.50	26@30	28@32	25.00
Kansas City	12.00	13.00	.....	26@35	35.00
Los Angeles	8.00	8.50	24.00	24.00	.....
Minneapolis	.....	8.50	.....	30.00	.....
Montreal	21.25	.....	35.00	.....	.....
New Orleans	10.50	14.50	40.00	45.00	40.00
New York	9.50	11.50	28.00	30.00	45.00
Philadelphia	.....	13.00	.....	25@30	40.00
Pittsburgh	8.00	10.00	18.00	22.00	25.00
St. Louis	.....	12.00	.....	22.00	30.00
San Francisco	.....	14.00	.....	.....	45.00*
Seattle	12.00	14.00	.....	.....	48.50

*2½x8½x4-in. †3½x8½x4 in.

LIME — Prices of hydrated, per ton, in paper; lump, per 180-lb. bbl., net:

	Hydrated Finishing		Hydrated Common		Common Lump.	
	F.o.b.	Delivered	F.o.b.	Delivered	F.o.b.	Delivered
Atlanta	$13.50	$18.00	$11.50	$15.50	.....	$2.50
Baltimore	.....	23.00	.....	13.00	.....	....
Birmingham	.....	21.00	.....	12.00	.....	1.65
Boston	16.00	18.00	10.00	12.00	$1.85	2.10
Chicago	.....	20.00	.....	14.00	.....	2.75
Cincinnati	11.00	12.00	9.40	10.40	.....	....
Cleveland	10.50	14,00	8.50	12.00	.....	2.50
Dallas	.....	20.00	.....	.....	.....	2.50
Denver	.....	30.00	.....	22.00	.....	2.85*
Detroit	8.90	14.00	7.00	12.00	.....	....
Kansas City	.....	22.00	.....	.....	.....	2.75
Los Angeles	24.00	26.00	17.00	18.00	.....	2.00
Minneapolis	.....	21.00	.....	19.00	.....	1.70
Montreal	.....	18.00	12.00	13.00	.....	....
New Orleans	14.75	22.50	11.58	14.00	1.66	1.95
New York	10.70	14.00	8.60	12.50	2.25*	3.15*
Philadelphia	11.50	15.39	9.90	13.49	.....	1.18
Pittsburgh	11.50	13.00	10.75	12.25	1.85	2.35
St. Louis	.....	.45‡	.....	.40‡	.....	2.15
San Francisco	19.00	.....	19.00	.....	1.59	.....
Seattle	.....	32.00	.....	24.00	.....	2.80

*Per 280-lb. bbl. (net.) ‡Per sack.

LIMESTONE—Mill blocks, f.o.b. siding, per cu.ft.:

New York: Rustic buff, $1.37; Standard gray, $1.47; Standard, $1.57; Selected gray, $1.57; Selected buff, $1.67.

Boston: Rustic buff, $1.43; Standard, $1.56; Selected buff, $1.70.

Pittsburgh: Rustic buff, $1.56; Standard, $1.28 at quarry; Selected buff, $1.86.

Philadelphia: Sel. buff, $1.65; Sel. gray, $1.55; Standard, $1.55; Standard gray, $1.45; Rustic buff, $1.35.

Atlanta: Standard, $1.26.

SLATE—Roofing, f.o.b. quarry, Bangor, Pa., net, per square;

No. 1 Clear	$8.25@$9.50
No. 1 Ribbon	6.75@ 7.50
Medium Clear	7.25@ 8.00

Road and Paving Materials

PAVING STONE — Granite, lots of 50,000 blocks, 4x8x4-in., dressed, f.o.b. city:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Birmingham	76.25 per M.
Boston	95.00 per M.
Chicago, 5 in	3.80 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	95.00 per M.
Detroit, 5 in	2.80 per sq.yd.
Kansas City	3.25 per sq.yd.
Minneapolis, 4½ in	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in	120.00 per M.
Philadelphia, 4x10x5	115.00 per M.
Pittsburgh	115.00 per M.
St. Louis, 5 in	2.90 per sq.yd.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING — Prices f.o.b., in carload lots:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.15
Chicago	3½	12	1.90
Kansas City	3½	16	2.50
Minneapolis	3½	16	2.25
Montreal	3½	16	2.63
New York	3½	14	1.90
Philadelphia	3½	16	2.02
St. Louis	3½	16	2.10

CURBING—Per lin.ft., 5x16 in., straight, rough, f.o.b., in carload lots:

Atlanta	$0.41	New York	$0.68
Birmingham	.50	Philadelphia (6x20 dressed)	1.40
Boston	.70	Pittsburgh	.80
Dallas	.60	St. Louis	.70
Detroit	.45		

ASPHALT—Paving asphalt, f.o.b., per ton. Packages are 350-lb. bbl. or 425-lb. drums, in carload lots:

	Packages	Tank-car or -boat
Atlanta	$18.40	$14.40
Baltimore (f.o.b. refinery)	16.00	12.00
Birmingham	.....	11.00
Boston	20.00	16.00
Chicago	22.50	15.50
Cincinnati (f.o.b. refinery)	......	8.00
Cleveland	18.25	14.50
Dallas	......	27.00
Denver	27.50	......
Detroit	16.80	12.43
Kansas City (f.o.b. refinery)	18.00	12.00
Los Angeles (f.o.b. refinery)	18.00	12.00
Maurer, N. J. (Bermudez)	......	25.00
Maurer, N. J. (Trinidad)	......	21.00
Minneapolis (f.o.b. Twin Cities)	20.00*	16.30
Montreal (f.o.b. factory)	17.00	13.00
New Orleans (f.o.b. refinery)	16.00	12.00
New York (f.o.b. refinery)	16.00	12.00
Philadelphia	16.00	10.00
Pittsburgh	25.00	16.00
St. Louis (f.o.b. refinery)	14.00	10.00
San Francisco (f.o.b. refinery)	14.00	8.00
Seattle (f.o.b. refinery)	16.00	10.00

* Refinery.

LIQUID ASPHALT — Residual, hot application, f.o.b., in tank cars. 8,000 gal. minimum, per gal.:

Atlanta	$0.06
Birmingham	.06
Boston	.055
Cincinnati	.075
Dallas	.05
Kansas City	.05
Los Angeles	.045
New York	.05
Philadelphia	.08
Pittsburgh	.05
St. Louis (at refinery)	.035

EMULSIFIED ASPHALT — For penetration and surface treatment, per gal.:

Boston, applied	$0.12
Cincinnati, f.o.b. refinery	.06
New York, applied	.15
Philadelphia, applied	.13
Pittsburgh f.o.b. refinery	.04@.06
St. Louis, applied	.12
Seattle, f.o.b. refinery	.055@.085

Iron and Steel

	Pittsburgh	Chicago	Birmingham	Cleveland
STRUCTURAL SHAPES AND PLATES, per 100 lb., base, carload lots	$1.60	$1.70	$1.75	$1.78
CONCRETE REINFORCING BARS, ¾ in., billet, per 100 lb., carload lots	1.60	1.65	1.75	1.50
SHEETS, per 100 lb., carload lots:				
Hot-rolled No. 10	1.55	1.65	1.85	.....
Hot-rolled annealed No. 24	2.20	2.30	2.35	.....
Galvanized No. 24	2.85	2.95	3.00	.....
TERNE PLATES, per package, I.C., 8-lb. coating, 20x28 in.	9.50	.....	.....	.....
RIVETS, per 100 lb., ¾ in., structural, carload lots	2.25	2.35	2.70	2.25
SHEETPILING, per 100 lb., base, carload lots	1.90	2.05	.....	....
WIRE NAILS, per 100 lb., base, carload lots	1.95	2.00	2.40	1.95
HEAVY MELTING STEEL SCRAP, No. 1, per gross ton, at consuming point	8.25	6.75	7@7.50	7.00

TRIANGLE MESH—Plain, per 100 sq.ft., 4 in. x 4 in., in carload lots:

Style Number	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mill
032	22	$0.94	$0.96
049	28	1.19	1.22
068	35	1.45	1.49
093	45	1.87	1.91
126	57	2.31	2.37
153	68	2.75	2.82
180	78	3.16	3.24
245	103	4.17	4.27
287	119	4.82	4.94
336	138	5.59	5.73
395	160	6.48	6.64
036P	17	.71	.73
053P	24	1.01	1.03

TRIANGLE MESH—*Continued.:*

Style Number	Weight in Pounds Per 100 Sq.Ft.	Pittsburgh Mill	Chicago District Mil
072P	31	1.27	1.30
097P	40	1.64	1.68
049R	24	1.01	1.03
067R	31	1.27	1.30
089R	40	1.64	1.68

WIRE ROPE—Discounts from manufacturers' list prices on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	25 %
Galvanized iron rigging and guy rope (add to list)	7½%
Galvanized steel rigging and guy rope	12½%
Plow steel round strand rope	40 %
"Special Steel" and extra strong cast steel, round strand rope	32½%

Discount 5 points less than discount for Eastern territory: California, Colorado, Kansas, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, Texas, Washington and Wyoming. Discount 10 points less than discount for Eastern territory: Arizona, Idaho, Montana and Utah.

EXPANDED METAL LATH—Per 100 sq.yd., painted, f.o.b., in carload lots 2.2 lb. per sq.yd., standard-mesh diamond lath:

Atlanta	$20.00*	Los Angeles	$17.00
Birmingham	14.50	New Orleans	20.50
Boston	15.00	New York	13.50
Chicago	10.60	Philadelphia	13.50
Cincinnati	11.00	Pittsburgh	13.50
Dallas	16.50	St. Louis	19.00*
Detroit	18.00	San Francisco	17.00*
Kansas City	17.00	Seattle	19.00

*Delivered.

STEEL FREIGHT RATES — Per 100 lb., effective Dec. 3, 1931, on finished steel products in the Pittsburgh District, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc.; 40,000 lb. per car:

Atlanta, 36,000 lb	$0.60	Detroit	$0.285
Baltimore	.29	Kansas City	.59
Birmingham	.60	New Orleans, 36,000 lb.	.69
Boston	.42	New York, 36,000 lb.	.35
Buffalo	.255	Pacific Coast, 60,000 lb.	1.17*
Chicago	.36	Philadelphia	.31
Cincinnati	.285	St. Louis	.41
Cleveland	.205	St. Paul	.60
Denver	.92		

* All rail.

Railway Materials and Supplies

STEEL RAILS—Standard rails have been $43.00 per gross ton since Sept., 1922, at which time the price was $40.00; other rails, per gross ton, f.o.b., as follows:

	Pittsburgh	Birmingham	Chicago
Light rails	$32.00	$32.00	$34.00
Re-rolled rails	21@23	.....	27.00

RAILWAY TIES — Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$1.00	.....
	Pine, untreated	.90	.....
	Pine, creosoted	1.40	.....
New York	Long-leaf sap pine, untreated	.90	$1.10
	Dense yellow pine, untreated	.65	.85
Birmingham	White oak, untreated	.90	1.05
	White oak, creosoted	1.45	1.55
	Southern pine, untreated	.45	.90
	Southern pine, creosoted	1.05	1.40
Chicago	White oak, untreated	1.05	1.35
	Oak, empty cell, creosoted	1.40	1.80
	Oak, zinc treated	1.25	1.65
	Southern pine, creosoted	1.15	1.50
Los Angeles	Fir, untreated	.47	....
	Fir, creosoted	1.20	....
Philadelphia	Red oak, untreated	.95	1.15
	Red oak, creosoted	1.47	1.90
St. Louis	White oak, untreated	.75	1.25
	Red oak, untreated	.70	1.05
	Red oak, creosoted	105	1.70
	Sap pine or cypress, untreated	.60	1.00
San Francisco	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

TRACK SUPPLIES — Prices per 100 lb., f o.b., for carload lots:

	Pittsburgh	Birmingham	Chicago
Angle bars	$2.75	$2.75	$2.75
Standard spikes	2.60	2.60	2.60
Tie plates	1.85	1.85	1.85
Track bolts	3.50	3.50	3.50

Pipe

WROUGHT STEEL PIPE — Discounts from standard list for delivery from warehouse, except at Pittsburgh, where prices are f.o.b. mill. List prices per ft. as follows: 1-in., 17c.; 3-in., 76½c.; 3½-in., 92c.; 6-in., $1.92.

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Atlanta	44%	36.5%	42%	34%
Boston	55.5%	42.25%	51.35%	40.1%
Chicago	57.25%	44.71%	53.83%	41.29%
Cleveland	53.3%	42.3%	50.8%	37.8%
Denver	44.5%	32%	41%	28.5%
New York	56.14%	43.6%	52.72%	40.18%
Philadelphia	58%	47%	55%	44%
Pittsburgh	64%	52.5%	61%	49.5%
St. Louis	51%	38%	48%	35%

Current Prices of Construction Materials

Pipe—Continued

CAST-IRON PIPE — Prices per net ton, for bell and spigot pipe, Class B and heavier, f.o.b. in carload lots; gas pipe and Class A, $3.00 per ton extra:

	4-In.	6-In. and Over
Atlanta	.....	$42.00
Boston	$38.00	35.00
Birmingham (Base)	32.00	29.00
Burlington (Base)	32.00	29.00
Chicago	37.40	33.40
Dallas	47.50	46.00
Los Angeles	39.00	36.00
New York	30.20	27.50
Philadelphia	30.00	27.00
Pittsburgh	38.50	35.50
St. Louis	43.00	40.00
San Francisco	48.00	45.00

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.125	$0.21	$0.385	.....	$1.40.	.....	......
Baltimore	.10	.30	.58	.....	1.93	.....	$6.50
Birmingham	.18	.30	.54	$1.02	1.95	$3.50	5.00
Boston	.17	.22	.52	1.30	2.20	4.60	5.70
Chicago	.18	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.108	.21	.324	1.05	1.755	3.528	5.4325
Cleveland	.135	.21	.405	1.125	2.025	4.824	7.38
Dallas	.23	.325	.586	1.106	1.95	3.68	5.00
Denver	.16	.23	.414	.816	1.44	.....	......
Detroit	.0855	.....	.2625	.....	1.90	3.80	......
Kansas City	.21	.335	.52	1.00	1.90	3.80	......
Los Angeles	.2175	.2825	.5085	1.1865	2.034	3.69	......
Minneapolis	.18	.23	.46	1.20	1.85	3.20	4.26
Montreal	.30	.45	.75	1.95	2.60	.....	7.20
New Orleans	.18	.30	.54	1.02	1.95	.....	......
New York	.13	.21	.42	1.15	2.10	.....	......
Philadelphia	.081	.126	.243	.65	1.17	2.376	4.615
Pittsburgh	.09	.18	.27	.62	1.22	2.45	3.68
St. Louis	.1295	.210	.378	.945	1.62	3.20	4.40
San Francisco	.175	.25	.45	1.05	1.80	3.00	4.50
Seattle	.22	.30	.54	1.26	2.16	2.50	5.50

CLAY DRAIN TILE—Per 1,000 lin.ft., f.o.b., in carload lots, 4 in.:

Atlanta	$50.00	Los Angeles	$60.00
Birmingham	50.00	New Orleans	40.00
Boston	43.00	New York	35.00
Chicago	40.00	Philadelphia	36.00
Dallas	65.00	Pittsburgh	80.00
Denver	75.00	St. Louis	40.00
Detroit	40.00	San Francisco	67.50
Kansas City	70.00	Seattle	60.00

Miscellaneous

LINSEED OIL—Raw, in 4-bbl. lots, per lb., f.o.b.:

Atlanta	$0.055	Minneapolis	$0.066
Birmingham	.08	Montreal	.54
Boston	.0725	New York	.061
Dallas (per gallon)	.073	Philadelphia	.059
Denver	.0893	Seattle	.075
Kansas City (per gal.)	.51	St Louis	.068
Los Angeles	.0866	San Francisco (del)	.1125

WHITE LEAD—In oil, per 100 lb. keg., f.o.b.:

Atlanta	$12.50	Los Angeles	$11.50
Birmingham	12.50	New Orleans	11.00
Boston	12.00	New York	12.00
Dallas	13.00	Philadelphia	9.50
Kansas City	12.13	Seattle	11.00
		St. Louis	12.00

Note: Both white and red lead, dry, same prices as foregoing; red in oil, $1.50 higher

CHEMICALS—Water, sewage treatment, road work, f.o.b., carlots, New York:

Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.75
Calcium chloride, 77-80%, flaked, in 400-lb. drums, f.o.b. works, per ton	21.00
Chlorine, cylinders, per lb	.04
Silicate of soda, in drums, f.o.b. works, per 100 lb. (40 deg.)	.75
Soda ash, 58%, in bags, per 100 lb.	1.17½
Sulphate of aluminum, in bags, per 100 lb	1.25
Sulphate of copper, in bbl., per 100 lb.	2.75

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¾-*in.*, 6-ft., 1-in.; ⅞-*in.*, 4-ft., 5-in.; *1-in.*, 3-ft., 8-in.; *1¼-in.*, 2-ft., 5-in.; *1½*-in., 1-ft., 8-in. Following prices are per lb. for ¾-in. and larger, delivered in 1,200 ft. coils:

Atlanta	$0.18	Kansas City	$0.21
Baltimore	.225	Los Angeles	.1725
Birmingham	.20	Minneapolis	.175
Boston	.16	Montreal	.1625
Chicago	.175	New Orleans	.185
Cincinnati (f.o.b.)	.21	New York	.165
Cleveland	.21	Philadelphia	.15
Dallas	.25	St. Louis	.155
Denver	.184	San Francisco	.155
Detroit	.185	Seattle	.175

BUILDING PAPER—Black, 50-lb. per roll of 500 sq.ft., in carloads, f.o.b., producing point.......... $1.80

SLATERS FELT—In carloads, per roll, f.o.b., producing point.......... $0.65

PREPARED ROOFING—Per square, f.o.b., in carload lots:

	Single Shingles*	Strip Shingles†	Rolls‡
Atlanta	$5.85	$6.25	$2.05
Boston	6.75	6.50	2.65
Dallas	5.25	4.50	2.25
Detroit	.....	.....	2.00
New Orleans	5.60	5.50	2.00
New York	6.50	6.25	2.50
Philadelphia	5.85	5.00	1.85
Seattle	......	6.60	2.55
St. Louis	3.80	3.65	1.40

*Slate finish, sufficient to cover 100 sq.ft.
†4 in 1, hexagonal shape, with Underwriters' label.
‡Slate surfaced, in rolls weighing 85 to 90 lb.

ROOFING MATERIALS—In carload lots, f.o.b.:

	Asphalt Felt, per 100 Lb.	Tar Felt, per 100 Lb.	Asphalt Coating, per Gal.	Tar Pitch,* per Ton
Atlanta	$44.50†	$44.50†	$0.45	$44.50
Boston	2.50	2.50	0.35	30.00
Dallas	3.25	3.50	1.00	42.00
Denver	2.00	2.00	.90	18.00
New Orleans	.....	2.50	.....	22.50
New York	2.40	2.40	.34½	28.00
Philadelphia	2.25	2.25	.35	22.00
Seattle	2.40	2.40	.55	27.90

*In 350 lb. barrels.
†Per ton.

WINDOW GLASS—Discounts from latest jobbers list, dated Sept. 15, 1928, for sizes above first three brackets:

	Single Thickness		Double Thickness	
	A Quality	B Quality	A Quality	B Quality
Atlanta	85%	85%	85%	85%
Birmingham	89%	91%	89%	91%
Boston	85%	90%	86%	90%
Dallas	85%	87.5%	87.5%	89.5%
Denver	84@5%	86@5%	84@5%	86@5%
Kansas City	90@5%	90@5%	90@5%	90@5%
New York	87%	89%	87%	89%
Philadelphia	88%	90%	88%	90%
Pittsburgh	87%	89%	87%	89%
Seattle	90@10%	90@20%	90@10%	90@20%

EXPLOSIVES—Price per pound for dynamite delivered:

	Gelatin			Gelatin	
	40%	60%		40%	60%
Atlanta	$0.215	$0.2375	Los Angeles	$0.1725	$0.1925
Baltimore	.21	.225	Minneapolis	.18	.195
Birmingham	.13	.1525	Montreal	.1675	.1925
Boston	.225	.25	New Orleans	.195	.22
Chicago	.17	.195	New York	.245	.2675
Cincinnati (f.o.b.)	.22	.245	Philadelphia	.215	.24
Dallas	.28	.30	St. Louis	.1975	.2175
Denver	.19*	.21*	San Francisco	.155	.18
Kansas City, Mo	.2025	.2225	Seattle	.1525	.175

*F.o.b Louviers.

Lumber

LUMBER—Per M. ft., b.m., No. 1, Common, rough, in carload lots:

PINE

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x 12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b.
Atlanta	$14.00	......	$15.00	......	$35.00	......	$45.00
Baltimore	......	$46.00	......	......	......	$70.00	......
Birmingham	......	15.00	......	$15.00	......	18.00	25.00
Boston	30.00	35.00	32.00	37.00	40.00	45.00	73.00
Chicago	......	......	......	......	......	62.50	......
Cincinnati	......	28.00	......	28.00	......	35.00	35.00
Cleveland	30.00	38.00	32.00	40.00	46.00	54.00	......
Dallas	......	32.50	......	32.50	......	47.50	55.00
Denver	......	31.00	......	33.00	......	45.00	......
Detroit	29.00	29.00	30.00	30.00	32.00	32.00	......
Kansas City	22.00	......	23.00	......	45.00	......	......
Minneapolis	......	31.00	......	31.00	......	36.00	......
Montreal	45.00	......	52.00	......	67.00	......	......
New Orleans	......	15.50	......	16.50	......	52.00	......
New York	22.50	24.00	23.50	25.00	27.00	29.00	......
Phil. (No. 2 com.)	18.00	22.00	19.00	23.00	29.00	33.00	68.00
Pittsburgh	20.00	33.00	20.00	33.00	32.00	39.00	46.00
St. Louis	22.00	27.00	23.50	28.50	47.00	52.00	45.00

FIR

	1 x 6 In.*		1 x 8 In.*		3 x 12 In.†		12 x 12 In.†
	F.o.b.	Del.	F.o.b.	Del.	F.o.b.	Del.	F.o.b.
Baltimore	......	......	......	......	......	$46.00	......
Boston	$28.00	$33.00	$30.00	$35.00	$33.00	38.00	$53.00
Chicago	......	......	......	......	......	44.52	......
Cincinnati	......	......	......	......	......	42.50	42.50
Cleveland	30.00	38.00	32.00	40.00	46.00	54.00	......
Dallas	30.00	31.00	29.00	30.00	38.00	40.00	36.75
Denver	......	34.00	......	36.00	......	47.00	......
Detroit	......	......	......	......	30.00	30.00	......
Kansas City	30.00	......	32.00	......	33.50	......	......
Los Angeles	39.00	41.50	39.00	41.50	43.00	45.50	40.00
Minneapolis	......	31.00	......	31.00	36.00	40.00	......
New Orleans	......	20.00	......	20.00	......	42.50	......
New York	21.50	23.00	22.50	24.00	24.00	26.00	......
Philadelphia	......	......	......	......	......	28.00	30.00
Pittsburgh	......	......	......	......	58.00	63.00	48.00
St. Louis	30.00	35.00	30.00	35.00	33.00	38.00	33.00
San Francisco	......	......	......	30.00	......	32.00	......
Seattle	10.00	11.00	10.00	11.00	14.00	15.00	......

*Form lumber, 16 ft. lengths. †Planks and timbers, 20 ft. lengths.

PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442